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THE OPPOSING LEADERS IN THE PHILIPPINES.

HEREWITH are presented portraits of Aguinaldo and other leaders of the revolt against Spanish rule in the Philippines, and also of Captain-General Augustin, who represents both the military and civil power of the Spanish crown.

All the insurgent chiefs have a youthful look due to an admixture of Tagil, Malay—and perhaps also some Chinese—and Spanish blood. Aguinaldo certainly might be mistaken for a mild-tempered student with theological leanings, though this, however, if reports are to be believed, hardly comports with his true character. Immediately following the destruction of the Spanish fleet in Manila Bay, Consul-General Williams secured to Aguinaldo, who for excellent reasons had fled from Luzon to Hong-Kong, passage on the United States revenue steamer "McCulloch" to Cavité. Besides the substantial aid furnished by the consul, on recommendation of the latter Admiral Dewey contributed further supplies in the way of weapons, ammunition, rations, etc., and Aguinaldo proceeded to organize an insurgent force that has rendered our government material assistance at times, and is said to have also completely invested Manila. This latter is even admitted through official Spanish sources. It is even believed the city would have fallen before this but for the restraint exercised by the American admiral, who, apparently, feared excesses on the part of the insurgents that would be entirely beyond his control; for a force from the fleet sufficient to preserve order, or hold strategetical points, manifestly could not be spared.

It is highly probable also that Admiral Dewey does not fully trust the insurgent leaders; and this is made more apparent by the fact Aguinaldo, on June 12, announced he had formed a provisional government, though, at the same time, the assurance was given this action was "merely for cohesive purposes," and that he, with the majority of his following, were desirous the Philippines should become a colony of the United States. All this, however, sounds somewhat inconsistent with the fact that Aguinaldo has caused himself to be elected, or to be proclaimed, "President of the Philippines;" and still later has manifested an eager desire to know the intents and purposes of the American government, throwing out hints to the effect he has been approached by the Spanish authorities and by German envoys.

All this, of course, may mean little, nothing, or diametrically the contrary. It is suggestive, however, of treachery and, in the near future, of an expenditure of no small amount of blood and treasure, if the Philippine Archipelago is to be held. Certainly the United States cannot now turn the islands over to the insurgents, which would mean anarchy and a complete uprooting of civilization until such time as some strong foreign power would intervene. Having "put hand to the plow," it behooves us not to "turn back." General Merritt will doubtless have sufficient force placed at his disposal, and he is well known to possess the necessary executive ability to bring order out of chaos, and pacificate and hold the islands.

Captain-General Augustin has apparently rendered excellent military services to his government, and thereby obtained somewhat unusual and rapid promotion, for he is still a comparatively young man. It is rumored he is a strict disciplinarian and withal a bit of a martinet, perhaps; that he is also a man of in-

Francisco. Tino. Paterno. Belarmino. Viola. F. Paterno. Vinlegra. Aguinaldo. Pilar. Mascordo. Covinting. Artacho. Navidad.

THE SPANISH-AMERICAN WAR—AGUINALDO AND THE CHIEFS OF THE REVOLT IN THE PHILIPPINES.

domitable bearing and inflexible will, yet in private life, or when occasion demands, of a most winning and pleasant demeanor. Again, like all Spanish governors, he is accused of filling his coffers at the expense of his government and the public at large, which, if true, is not at all surprising, considering such acts are tolerated by the people at large. For our engravings we are indebted to L'Illustration.

PORTO RICO: ITS NATURAL HISTORY AND PRODUCTS.

PORTO RICO belongs to the group of islands or archipelago called the "Antilles," and is the smallest of the Greater Antilles; and close to it lie the islets of Culebra, Vieques, Caja de Muertos, Mona, Monito Desecheo, and others still smaller. It is situate some seventy miles to the eastward of San Domingo, between latitude 17° 5' and 18° 30' north and longitude 65° 35' and 67° 10' W. (G.) The nearest lands to the east are the Isle of Vieques and the Virgin group. In shape it is like a parallelogram, the longer sides extending east and west, and measuring about 108 miles, the shorter 37 miles, embracing an area of about 3,530 square miles and supporting a population, according to the census of 1887, of 798,565, of which 474,933 are whites, 246,647 mulattoes, and 76,985 blacks.

THE COAST.

On the eastern coast are several points frequented by coasting vessels. Starting from Cape San Juan, the extreme northeastern point of the island, and going south, the first port is Fajardo, a narrow channel protected by the little islands of Obispo, Zancudo, and Ramos, and a connecting reef, with only a few openings. The harbors of Naguabo and Humacao, even though open to the wind, offer good anchorage, and are situate in the bay that extends from Luna Point on the northeast to Icacos Point. The port of Yabucoa lies south of Humacao and almost opposite Point Arenas de Vieques. That of Maunabo is bounded on the south by Cape Mala Pascua, and the inhabitants live back on the banks of the river that flows into the harbor. Patillas is six miles west of Cape Mala Pascua. The harbors generally on the eastern coast are good, since the east winds keep the sea constantly smooth.

The northern coast is rugged and at the eastern end very high; it extends in almost a straight line east and west, offering scarcely any shelter between Cape San Juan and the port of that name. This stretch of coast seems to be shut in by a reef, with many cays, over which the sea breaks with fury. The harbor of San Juan de Porto Rico is situate about thirty miles west of Cape San Juan and the city of the same name, which is the capital of the island. The city is built on a slope facing the northeast, and protected by Morro Castle and other batteries. One mile from Point Morrillos is the city of Arecibo, and the river of this name offers a highway for the rich products that are grown along its banks. Aguadilla Bay, into which Rio Grande or Culebrina flows, affords a good harbor, sheltered from the usual winds, but difficult to cross during a gale from the north.

Further to the south is Point San Francisco, opposite Desecheo Island, which, with Point Cadena, forms the Bay of Rincon; here there are several shoals. Six miles from Point Cadena is Algarrobo Bay, a large sheltered harbor, into which the Añasco flows. Next come the Bays of Mayagüez, Guanajibo, Vigo, Rojo, and Boqueron. Here the climate seems to change completely, as do the products of the island, for while the northern part is fertile, moist, abounding in pastures and groves, in the southern there is a range of arid and barren hills. Point Aquila is the southwest extremity of the island, and is very dry, arid in the highlands and marshy in the lowlands.

The southern coast, which is but very poorly shown on most charts, must be approached with the greatest care; for, although it includes several good harbors between Cape Rojo and Point Brea, these are inaccessible to one who is not familiar therewith. The harbor of Guánicas, east of Cape Rojo, affords the best anchorage, there being from 16 to 33 feet of water over a sandy or gravelly bottom.

There is nothing remarkable on the coast to the windward of Guanicas until the cliffs of La Ventana are reached, which, with Point Vaquero, forms a little bay in which lies Aguadilla, the leeward side of which is filled up by slides from the mountains. A range of hills starting from the mouth of Guayanilla Bay toward the east, with the coast, forms a passage that is navigable for vessels that do not draw over seven feet. The cay of Caribé connects with that of Media Luna, and these, with Cuebara, form a passage to Tallaboa Bay.

Further to the east are Guayanilla, Matanza, Cay Ratones, and finally Ponce, the latter one of the most important cities on the island. Not far to the southeast lies the island called Caja de Muertos. The port of Santa Isabel is protected only slightly by Point Coamo, and vessels cannot lie here when the wind is southeast or south, because of the high sea and ugly character of the breakers. Turning to the south, passing by cays and through a passage perhaps 33 feet deep, the village of Jauca is reached, and finally the Bay of Salinas, formed by Point Coamo and Point Salinas, and inclosing in its northeast corner the famous port of Jobos, a natural dock which extends three miles inland from west to east, is one mile wide, the water being from 16 to 23 feet deep over a loose mud bottom; the mud is always stirred up by a strong wind. The town of Guayamas, whose church serves as a guide between Salinas and Cape Mala Pascua, lies at the foot of a hill which commands a view of an extensive, fertile, and picturesque plain, being at the upper vertex of a triangle, the other vertices being at Jobos on the west and at Arroyo on the east. The harbor of Guayama and the Bay of Arroyo are one and the same thing.

TOPOGRAPHY.

Porto Rico is very mountainous in the interior, and, with few exceptions, level near the coast, which latter is, as a rule, the most thickly inhabited and the richest. The island may be said to be divided into two parts, the northern and the southern, which are separated by a range extending from east to west, with a slight inclination toward the southwest. Several spurs extend as far as the coast, forming cliffs, as at Cape San Juan, in the northeast part of the island, at Cape Mala Pascua at the southeast, and on the northwest between Quebradillas and Rincon, where the last spurs of the Corozas end. The spurs that extend toward the coast in other parts of the island are low, so that the roads can be easily made over them. Part of the central range is called "Sierra Grande" or "Barros," and on the eastern end, toward the north, is the Sierra del Loquillo or Luquillo, the highest point of which, Yunque, reaches an elevation of 4,987 feet. It is said that this mountain was named for an Indian chief who resisted Spanish rule until the conquerors—considering him a lunatic (loquillo)—finally let him alone in this rough country. The principal peaks of the central range, on the northern side and near the coast, are called Ciales, while those on the south form the Sierras

AGUINALDO.

de Cayey, prolonged toward the west by the Sierra de Coamo. On the northwestern part of the island is the Sierra de Láres, and farther south are other sierras and cerros (hills), among them Cerro Montuoso and Tetas de Cerro Gordo, and still nearer the southern coast, Cerro de la Torre. The spurs of these ranges that extend to the coast form beautiful valleys watered by rivers, some of which are navigable for short distances. Between the towns of Barranquitas and Barros, the mountains of the same name attain a height of 4,265 feet; Mata de Plátanos, near Peñuelas, is 2,979 feet; Torito, near Cayey, 2,812 feet; Silla de Guilarte, near Adjuntas, 2,618 feet; Cerro Gordo, at San German, 2,198 feet.

In these sierras there are very curious caves, among which those of Aguas Buenas and Ciales are worthy of mention. In the former there are beautiful stalactites, deep fissures, and a multitude of bats; in the latter

CAPTAIN-GENERAL AUGUSTIN.

the hand of man has been at work, and there are large halls with seats against the walls. Another noteworthy cave is that of Consejo, at Arecibo, an opening in the living rock, which seems to have been hewn out with a pick.

The number of rivers and small streams that flow through the hilly surface of the island is considerable, and their currents are very strong, because of the steepness of the ravines and the abundance of rain. The larger and more numerous are on the northern slope, both because the ravines are here more extensive and because of the frequent and copious rains which fall almost daily.

The Sierras Barros and Cayey may be considered the main dividing line. North of the latter flows the Loysa River, which rises in the Sierra Luquillo; on the right are Bayamon and Toa Rivers. To the north of Sierra Barros are Manatí and Areeibo Rivers. The streams between the Sierra Cayey and the southern coast are very short, the longest being Guayama. Those on the southern slope of this sierra are larger, as, for instance, the Salinas and the Coamo, between which rises the Sierra de Coamo, and the Descalabrao, Jocaguas, and Peñuelas.

Three streams of relative importance flow into the sea on the western coast, viz., the Culebrina, the Añasco, and the Guanajibo. Those on the eastern coast are short, among them being the Fajardo, Naguabo, Anton Ruiz, Humacao, Candelero, Limones, and Maunabo.

The largest of the lagoons is that of Guanica, but Manatí, Arecibo, Aguadilla, and Cabo Rojo are also worthy of mention.

GEOLOGY AND MINES.

From a geological point of view the island may be divided into four zones, viz., eastern, northern, central, and southern. The ancient rocks predominate in the eastern, being approximately limited toward the interior by Loysa River, and by the western and northern spurs of the Sierra de Luquillo toward the ends of the Rio Grande on the north, by Gurabo and Caguas in the center, and Patillas and Arroyo on the south. In this zone those portions of Sierra del Luquillo near Yunque Peak and its extreme eastern spurs are, according to Martinez Alcibar, formed of primitive slate raised by the eruption of the diorite, syenite, granite, and other plutonic rocks; porphyry diorite is also found in loose blocks and in other rocks, in masses. The primitive slate, which in some places may be confused with the amphibolic, has a double, pseudo-regular, tetrahedral structure; it presents fissures parallel to the stratification, and oblique to it in various directions, so that where it is slightly decomposed it is easily divided into tetrahedral fragments. These fissures are filled with calcareous spar, quartz, or iron pyrites. In the rock on the northern part is a zone that extends from east to west, from the coast near the city of Luquillo as far as the western branch of Mameyes River; as one ascends the mountain the rocks contain more minerals, and the fissures filled by quartz and calcareous spar are succeeded by those filled with iron pyrites, and the mass of the slate becomes more ferruginous until the point is reached where the syenites are in contact with the stratified earth.

The northern zone consists principally of tertiary formations, in a strip that extends from east of Loysa to the northern part of the western coast of the island. The southern limit of the strip is bounded by a line that extends from Rincon, south of Aguada, toward east by north of Añasco, Las Marias, north of Utuado, Ciales and Morövis, to near Aguas Buenas. The predominating rocks in this formation are arenaceous and chalky in thick inclined strata, on which rest in irregular stratification larger strata of coarse limestone. The central zone extends south of this line, and here cretaceous earth predominates between the western coast and the limit of the ancient earth on the east, approaching close enough to the sea at the south to reach to Sabana Grande, Peñulas, Juana Diaz, and Guayama. It is very probable that in the cretaceous some Jurassic sediments may also be found, as in the island of Cuba. The rocks, whatever may be their age, are calcareous, semi-crystalline, and marmorean, as well as argillaceous and marly, the composition being quite variable. On the western coast of this zone, north and south of Mayagüez, quaternary formations are found, probably deposited there by the alluvium, of Mayagüez and Guanajibo Rivers. This rock is interrupted in several places by ancient baric rocks essentially ophitic, in which hornblende plays an important part, as do also serpentine and trap rocks. The strips are such as appear in Montoso, in Maricao, between Utuado and Adjuntas, which are prolonged toward the east to the western end of Barros; those of Algarrobos and Lapa to the east of Coamo, and that which, on the north, comes in contact with the tertiary formations east of Moróvis.

Finally the southern coast, between Cape Rojo and Guayama, is another tertiary strip, interrupted by one and another formation and rock, among them the little zone of trachyte which is found north of the swamps or salt marshes of Guánica in the western part, south of San German and Sábana Grande.

Observing the great extension of the tertiary formation consisting of strata which have a thin and uniform seam toward the north, it would seem that the present surface of Porto Rico was formed by the slow and gradual rise of the ground in a longitudinal line from east to west, which is the general direction in which the island extends, and this phenomenon must have taken place after the Miocene formation. In some little islands to the windward, rocks of a very marked volcanic character are often found.

In the opinion of Rojas, Porto Rico is outside of the seismic currents which extend under the ocean from the Old World to the New, and consequently it alone of the Antilles group has thus far been free from the great seismic movements which have ruined many American towns. Nevertheless, and doubtless on account of the proximity to the volcanic region of the islands of San Vicente, Santa Lucia, and Guadalupe, slight earthquakes are apt to be felt, and on two occasions they were worthy of being called severe, these at the end of April, 1786, and in 1843, when the city of Martinique was ruined. Slight quakes were also felt in 1867 and in March of the following year. In the beginning of 1882 it was noticed that the waters in the bays of Mayagüez and Ponce retreated two or three times to a level more than 30 feet below the ordinary water line on the coasts, and this phenomenon coincided with earthquakes at Colon and Panama.

The commonest minerals are gold, copper carbonate and sulphate, and magnetic iron, which are found in great masses in the neighborhood of Juncos; galena is also found, as well as traces of mercury, manganese, bismuth, and some other minerals. The fuels are represented by the lignites of Utuado and Moca, although they occur in thin layers and are generally charged with pyrites; at the latter place also yellow amber is found. There is an abundance of varieties of marble and compact limestone, and in general materials for construction and ornamentation. In the Historical

American Exposition at Madrid, in 1892, were exhibited remarkable examples of magnetic iron, oxide of iron, and carbonate of copper, all from Juncos; also ferruginous white quartz from the auriferous zone of Sierra Luquillo and calcareous spar, pearl spar, fibrous gypsum, malachite, and pure blue copper from Naguabo.

Native gold is found principally in the alluvial deposits and in the rivers in the vicinity of Luquillo. When auriferous sand is washed, it is found that in some places there is a deposit of magnetic iron with the grains of gold.

There are natural salt marshes at Guánica and Salinas on the south and at Cape Rojo on the west. Hot springs are found at Juana Díaz, San Sebastian, San Lorenzo, and Ponce, but the most famous are the baths of Coamo on the south and near the city of Santa Isabel.

CLIMATE AND PRODUCTS.

In general terms both the climate and products are those common to the Antilles; therefore, the climate may be called warm, and although, according to some authors, the temperature rises as high as 116° F., the east winds which prevail almost constantly modify the rigors of the tropical sun, and a shaded thermometer placed in the open air at the level of the sea seldom rises in calm weather higher than 96° F. during the heat of the day, and at night it fails to 68° or 70°.

Observations carried on for ten years show that 81° is the average temperature. From 1878 to 1880 the thermometer in the shade ranged from 62·96° to 78·8° F. The monthly average varied from 72·32° to 86·07° F., the former being for the month of February, 1880, and the second for June, 1878. The mean height of the barometric column was about 30 inches.

The rainy season lasts from August to December, and, as is usual in tropical countries, enormous quantities of water fall, inundating the fields and forming ponds and swamps, which give rise to pestilential emanations that greatly endanger health; there is so much dampness that even iron flakes off. The total amount of water which fell in 1878 was upward of 60 inches, but the annual average is about 45 inches.

From time to time hurricanes and cyclones cause great damage. On July 26, 1825, several towns were destroyed and 300 people killed. The most common diseases are yellow fever, elephantiasis, tetanus, malarial fevers, and dysentery.

The heat and humidity give the vegetation all the exuberance and beauty that characterize the flora of tropical countries; but the flora peculiar to the temperate zone is not uncommon at considerable altitudes. In the mountains there are more than 500 varieties of trees, among them the magnolia, bread fruit, American mammee, walnut, oak, etc. In the plains, palms, guava, sapota, and orange trees predominate; and everywhere are found forests affording a variety of medicinal and aromatic plants and wood that can be utilized for building and ornamental purposes, such as box, fragrant cedar, satin wood, mahogany, laurel, and lignum-vitæ.

Agriculture, however, is the chief source of income to the island, and large quantities of sugar, coffee, tobacco, cotton, and maize are raised, the crops that rank next in importance being plantain, rice, pineapple, medlar, and other fruits.

The "mountain dog," a reversion of the domestic species which haunts the more inaccessible forests and is dangerous only to calves, poultry, and young swine, is the only creature that can be termed "wild." Rats exist in abundance, but have a bitter foe in the otherwise harmless "hunter snake," a species of boa that grows from 6 to 9 feet in length. Ants and beetles are numerous, and one of the latter, known as the "comegen," bores into wooden structures, and is sometimes dangerous to buildings. Bees are comparatively plentiful in the forests, but are smaller than the domestic forms, and produce an amber-colored honey, very rich, but that speedily ferments and sours, and the wax is of a violet hue. "Lucernas" or fire-flies abound; they are like small butterflies with phosphorescent rings about the eyes, and when masses fly at night they produce sufficient light to illuminate the fields and plantations. There are also "cucuyos" similar to the cricket, which are phosphorescent under the wings. Some of the bats seek sleeping animals at night to suck their blood. The chigoe bites through shoes and stockings or enters between the nail and the skin; and copper worms, ticks, cockroaches, mosquitoes, chinches, etc., are most vexatious.

Among the fowls may be mentioned chickens, ducks, and guinea hens; among wild fowl, widgeons, black widgeons—that imitate the human voice—geese, teal, and herons. There are also nightingales, larger than those of Europe, but not such sweet singers, pigeons, doves, parrots, paroquets, and ravens. The commonest marine birds are the pelican and flamingo, which inhabit the little islands and cays. There is a remarkable abundance of fish on the coast and in the rivers.

INDUSTRY, COMMERCE, AND MEANS OF COMMUNICATION.

Agriculture, as before remarked, is the most important industry, but the methods used are most primitive.

There are no large agricultural establishments, except the cane plantations, and the best of the latter is the Fontana, Central de Vega Baja, which is the most complete on account of its fine sugar-making machinery, as well as the extensive scale on which its work is carried out, and its solid and elegant buildings. There has been very little development of the mineral resources. A few copper mines have been worked in Naguabo, and the people of Luquillo and Corozal wash the auriferous alluvium, getting about $6,000 to $8,000 worth of gold annually; and there are iron foundries in San Juan, Ponce, and Mayagüez.

In 1891 the importations amounted to $33,729,527 and the exports to $19,771,995. The principal exports are sugar, coffee, honey, and tobacco. In 1890 the ports of the island were entered by 1,294 vessels, having a total tonnage of 1,257,174 tons, and there cleared 1,274 vessels, with a tonnage of 1,231,189 tons.

Plans have been made for five first-class roads, viz.: From the capital to Ponce by Caguas and Coamo, a distance of 84 miles; from the capital (the suburb Catano) to Mayagüez by Arecibo and Aguadilla, 101 miles: Mayagüez to Ponce, 60 miles; from the first named road to Arroyo by Guayama, 21 miles; Caguas to the city of Naguabo by Humacao, 30 miles; making a total of 296 miles. A few miles of inferior roads have been constructed, viz.: From Arecibo to Ponce by Utuado and Adjuntas, 34 miles; Rio Piedras to the Port of Fajardo, 31 miles; from Lares to Aguadilla, 16 miles; a branch connecting the two first named roads through Guaynabo, 8 miles; making a total of 89 miles. The general plan for railroads consists of a line around the island divided into four sections: One from San Juan to Mayagüez by Arecibo and Aguadilla; from Rio Piedras or Humacao by Fajardo; from Ponce to Mayagüez by San German; from Ponce to Humacao by Arroyo, a total of 341 miles, of which, however, only 11 miles have been built. There are tramways from the capital to Rio Piedras, 7½ miles, from Ponce to the shore, from Mayagüez to the shore, and from Catano to Bayamon, 5 miles.

The telegraph system is divided into the Western Line, from the capital to Rio Piedras, Bayamo, Dorado, Vega Baja, Manatí, Arecibo, Aguadilla, Añasco, Mayagüez, Hormigueros, San German, Sábana Grande, Yauco, Guayanilla, and Ponce, and a branch to Cape Rojo. The Eastern Line extends from the capital to Cáguas, Gurabo, Juncos, San Lorenzo, Hermacao, Yábucoa, Maunabo, Patillas, Arroyo, Guayama, Salinas, and Ponce. The Central Line extends from the capital to Cayey, Aibonita, Coamo, Juana Diaz, Ponce and its bay, and the eastern branch from the capital to Carolina, Luquillo, Fajardo, Naguado and Humacao. This system has also been extended from Arecibo to Ponce, with stations in Ajuntas and Utuado. The total length of the lines amounts to 486 miles and that of the wires to 676 miles, and 152,786 dispatches were sent in 1892.

There are cables from the capital to St. Thomas, in communication with the Lesser Antilles and South America; from the capital to Jamaica, in communication with Cuba, the United States, and Europe; from the Bay of Ponce to Jamaica and Santa Cruz, connected with St. Thomas.

RECEIPTS AND EXPENSES.

According to the budget of 1893-94, the receipts amounted to $3,903,655, distributed as follows: general taxes, $1,053,500; customs duties, $2,300,000; stamps, $305,300; national property, $23,900; incidental receipts, $220,955. The expenses amounted to $3,879,813; general obligations, $802,407; Department of Justice, $352,598; War, $1,050,006; Navy, $159,458; Treasury, $250,045; Department of the Interior, $680,510; and Public Works, $593,789.

SUESS' THEORIES OF GEOGRAPHICAL EVOLUTION.*

IN spite of the apparent fickleness and inconstancy of the sea, the idea recurs throughout poetic literature that its main character is really its immutability. From Homer to Kipling, from Job to Matthew Arnold, poets have repeatedly expressed the idea,

"Time writes no wrinkle on thine azure brow,
Such as Creation's dawn beheld thou rollest now."

The teaching of uniformitarian geology supported the old notion of the poets. The change from

"There where the long street roars hath been
The silent stillness of a central sea"

was attributed to an oscillation of the land, not a variation in the level of the sea. The one level in nature that was taken as a reliable constant was the mean sea level. Gradually, however, the view has grown that Ordnance datum is as inconstant a constant as most earthly guides. Gradually the idea has been accepted that the surface of the sea is no more an absolute plane than is Salisbury Plain, but that it is heaped up against the margins of the continents in a manner analogous to the upraising of water against the margin of a basin. As soon as belief in the fixity of sea level was shattered, many an apparently well established geological hypothesis was shown to require modification or fresh proof, and many a geological principle to require restatement. If the water level in the Central Pacific could rise owing to a reduction in the attractive force of the land masses on its margin (as for example by the sinking of an Antarctic continent), then the formation of coral atolls might be formed, not by the slow subsidence of the sea floor, but by a gradual rise of the sea surface, as water flowed into the Central Pacific from its borders. Again, the apparent upraising of northern Scandinavia and subsidence of southern Scandinavia might be due not to an actual movement of the land, but to variation in the level of the two halves of the North Sea under the influence of changed winds and ocean currents, and the formation of a fresh outlet through the Straits of Dover.

The first geologist to realize the full geological significance of the inconstancy of the sea level was Prof. Eduard Suess, of Vienna. Recognizing the importance of this fact, he set to work to inquire if it could yield any help in developing a theory of geographical evolution. Geographers have always agreed that the distribution of land and water on the earth is not a haphazard arrangement, but is governed by some principle or law. There is, it is true, a remarkable dissimilarity between the different continents; but a closer comparison reveals many striking repetitions of the same arrangement. At first sight no two structures could look less alike than a quartz crystal, with its solid form and its simple outline, its flat faces and its straight edges, and a complex crystalline flake of snow, with its radiating cluster of feathery tufts of delicate filigree. But the crystallographer recognizes that the quartz crystal and the snow flake have the same simple hexagonal symmetry, and are built on the same fundamental plan. So the geographers have felt that if we neglect accidental topographical details, we find so many points of striking resemblance between the great land masses that there must be some underlying symmetry in continental form. A convincing statement of these coincidences was made by Prof. Lapworth in a lecture to the Geographical Society in 1894, and formed the text of his presidential address to the geological section of the British Association at Edinburgh in 1892.

Quite early in the century, geologists set to work to construct theories that would explain continental forms, but with little success. The well known southward direction of all peninsulas was stated in elementary text-books of geography, and was often explained as due to the southern hemisphere having a larger share of the ocean than its due, owing to its being heavier than the northern hemisphere. Several efforts have been made to attribute the direction of the main mountain chains to lines of weakness by torsion in the original crust of the earth. The theory is still popular, in spite of the overwhelming weight of paleontological evidence against it, that the ocean basins and the continental masses were determined in the prezoic period, and that they have been permanent throughout geological time. These theories of continental form have, however, been either so vague as to be useless or, if sufficiently definite to be helpful, they have been shown inconsistent with essential facts.

As M. Bertrand shows in an admirable preface to the French translation, Elie de Beaumont's brilliant speculations failed owing to his having filled the gaps in his foundation of facts by guesswork. Suess realizes this danger, and accordingly sets to work on a different plan. As he tells us at the outset, he repudiates preconceived notions; and in the first two volumes of his work tries to state the problem, rather than to solve it. In the spirit of the founders of the Geological Society, he holds that synthesis must precede analysis. "Das Antlitz der Erde" was therefore planned to consist of four parts, of which only three have yet been published. The first volume was issued in Vienna in 1885, and contained the first two parts; the third part, forming the second volume, followed three years later. A French translation is now issued for the first two parts. The work has been admirably done by M. de Margerie and a group of collaborators, who add many references and foot notes, and sometimes important interpolations in the text, in order to bring the work up to date. One very valuable addition to the French edition is an increased number of sketch maps. Many of the new figures are well chosen, and are very clear. The paucity of maps in the original issue was its one fault.

We owe M. de Margerie and his colleagues so much gratitude for the great labor of this translation that it is ungracious to criticise. But there is one improvement that might perhaps be made. The first volume left Suess' hands more than thirteen years ago. Many statements in the text he would now, no doubt, wish to qualify or withdraw. There is no word in the volume from its author to suggest what corrections he would wish to make, and how far it represents his present views. It might have saved much future misunderstanding if we had been told whether the reissue of some of the suggestions is to be taken as a proof that they are still regarded as probable by Prof. Suess.

The volume, of which the French translation has just been issued, consists of a short introduction followed by the seventeen chapters of the first two parts. Each chapter forms a masterly geological essay, and may be read separately with profit by specialists on the subjects discussed. Prof. Suess' knowledge of geological literature is colossal, and he illuminates every subject he treats with the light of his poetical imagination. Each chapter is a gem; but the thread by which they are to be strung into a connected chain has not yet been completely spun. It is not very easy, therefore, to summarize the work into a connected argument, which may, however, be stated somewhat as follows:

It is known that in many areas as, e.g., on the eastern coast of the Tyrrhenean Sea, there are detached fragments of ancient shore lines which rest in one place on the face of an abrupt spur from the Apennines, in another traverse a cliff of limestone round an old bay, and elsewhere lie on the old Archean rocks of Calabria or on the late Cainozoic tuffs of Etna. The old shore line, however, maintains its absolutely horizontality. Suess contends that it would be a physical impossibility for so complex an area, composed of beds of such different compositions, hardness, and dip, to have been upraised without any relative displacement of the different parts. Therefore, argues Suess, as the land cannot have been upraised, the sea level must have fallen. That alterations in the position of land and water are due to movements of the land is one of the fundamental principles of Lyellism. Suess, therefore, proceeds to inquire whether geological evidence supports Lyell's view, or whether there is any proof of actual variation in the form or position of the hydrosphere which would locally alter the height of its upper surface. The introductory chapter states the conclusions of the geodesists as to the existing inequalities in the sea surface. Then he asks is there any historical evidence as to the flooding of land areas without subsidence of the land? He tells again the Chaldean story of the Noachian deluge as revealed by The Daily Telegraph tablets; he concludes that the absence of similar traditions in Egypt proves that the flood was local, and he shows that the whole of the facts in the Chaldean version are explicable by a flooding of the Mesopotamian plain caused by earthquakes in the Persian Gulf. The great shock was, no doubt, preceded by preliminary shocks, which may have acted as a warning to the wise, and the great flood may have been increased by an accompanying cyclone. The author then proceeds to discuss some of the principles of dynamical geology in chapters on the forces that move the land masses. He first considers earthquakes, and describes four typical earthquake areas. He concludes that earth movements are of two kinds; foldings produced by tangential thrusts, as in mountain building, and subsidences produced by radial contraction. The uplift of large, uncontorted superficial areas he declines to accept. He discusses the oft-quoted assertion as to the elevation of the South American coast by earthquakes, and denies that the evidence supports that conclusion. He is here opposed to Darwin, so he goes into the case fully and appears to prove his contention. In order to get light as to the internal nature of the earth, he then turns to vulcanism. He describes the laccolitic habit of acid lavas and the broad flows and sheets of basic lavas, and proposes the term "batholites"* for those great masses of granitic rocks, which may perhaps be most briefly explained as plutonic laccolites, in which the

* A review of "Natural Science" of Ed. Suess' "La Face de la Terre (Das Antlitz der Erde)." Traduit sous la direction de Emmanuel de Margerie avec un preface par Marcel Bertrand. Vol. I., pp. xv., 835, 8vo, with 2 colored maps and 122 figures. Paris: Armand, Colin & Cie., 1897.

* An illustration of the extent to which Suess' work has been neglected in England is shown by the fact that, in the Geological Society's last discussion on the nature of the Dartmoor granite, though the question of its laccolitic origin was considered, the term batholite was not mentioned in the report.

igneous rock occupies a pre-existing cavity which it did not itself form. The existence of such cavities must be inferred in order to explain vertical subsidences. Hence, from a study of a series of typical earthquakes, geognostic dislocations and volcanic phenomena, Suess concludes that, in the processes of the earth's contraction by cooling, vast subterranean hollows are left, which are usually filled by a sinking of the superficial crust; while owing to tangential thrusts caused by the contraction of the outer crust, violent foldings are produced along certain lines. In some cases the lateral thrusts and the vertical subsidences are combined, but Prof. Suess can find no agency that will account for the uplift of large areas in mass and undisturbed.

The rest of the present volume is devoted to a series of descriptive chapters on the mountain system of the world. They are of high value as a summary of knowledge of the geology of the world up to the date at which the book was written; while M. de Margerie and his collaborators have introduced a series of foot notes, giving additional references to literature, and, in some places, incorporated important additions in the text. The descriptions are of high value, not only as a statement of facts, but for the original insight which enables Prof. Suess to point out the connection of distant and now isolated areas. The author begins with a description of the Alpine system and adjoining country geologically connected with it, of the fundamental geological structure of the middle zone of Europe. He describes the main structural lines of the Alps and of the great plateau belt (the Alpine Vorland), which sweeps across Europe from the high, treeless wastes of the Spanish meseta, the chateau-crowned crags of the central plateau of France, and the pine-clad "horsts" of the Schwarzwald and Thuringia, into the level, wind-swept Russian plain. Eastward he follows the Alps into the multiserial chains of "the world's white roof-tree" of Northern India and Thibet. South of the Alpine area he describes the subsided trough of the Adriatic, and the great basin of the Mediterranean; he shows that the latter is only the eastern arm of a long sea, which once extended from the Levant to Yucatan, and from the central part of which the Atlantic grew by the gradual enlargement of two gulfs that ran out north and south. South of the Mediterranean is the great tropical tableland; its northern part forms the deserts of the Sahara, Kordofan, and Arabia; the rest forms the great block of equatorial Africa, which once probably extended eastward to Southern India and westward to join the similar eastern highlands of Brazil.

In this manner Prof. Suess sketches out the development of existing continents. From the high standpoint of his wide knowledge, by the far-reaching penetration of his mental vision, he surveys all the mountains of the world; with splendid self-restraint he leaves behind him the temptation to premature theory; and he clearly brings out the essential facts upon which any theory of geographical evolution must be based. Into the apparently bewildering variety of topographic accidents he introduces harmony, bringing out the unity of structure, movement, and relations of the continental masses; thus "he draws the world together link by link." It is impossible to give any adequate idea of this work in a short summary. I feel it almost impertinent for a young geologist like myself to praise it; I can only recommend others to read it.

J. W. GREGORY.

CLIMATOLOGY AS DISTINGUISHED FROM METEOROLOGY.

THE term climatology is very frequently treated as synonymous with meteorology, says Milton Whitney, in Science. There is an important distinction, however, which should be generally recognized. Climatology is a distinct branch of meteorology, an application which should not be confounded with the broader subject. Meteorology includes, in the broadest sense, the various atmospheric phenomena. The subject may be conveniently divided into two parts: The study of the laws and principles involved in the movements of the wind; the formation of clouds; the formation and precipitation of rain, snow, and hail; the absorption and radiation of heat and the like. The second part consists of the statistical records of the extent and frequency of the changes of the various atmospheric phenomena. Climatology is a function of these phenomena and should be expressed in terms of the development of organic life. Climatic changes produce in many ways more apparent changes in plants than in animals, and they should be taken as the standard in the interpretation of our meteorological data. Many plants are far more sensitive in recording climatic changes than our meteorological instruments. There are localities where the character of the leaf or the peculiar excellence of the fruit produced show peculiarities in the climate which the instruments fail altogether to record, or rather which we have never yet been able to deduce from the ordinary meteorological records. The development of plant life should, therefore, be taken as the standard with which our instruments should be compared and our methods adjusted, in order that the elements of climatology may be worked out from our meteorological records.

Climatology is not a simple summation, but a complicated expression involving the general relation of certain functions of meteorological elements, the values of which we do not as yet understand. The principal elements influencing the economy of plant life are temperature, humidity, wind velocity, water supply, and sunshine. Within certain limits the activities of the plant are dependent upon the relation between these elements. Thus temperature causes evaporation, the relative humidity and the velocity of the wind control evaporation, while the moisture supply in the soil provides the plant with water to replace that lost by evaporation. The influence of all depends upon the total intensity of the sunshine. The rainfall, although a very important meteorological element and of great economic and commercial importance, is not considered a factor in climatology, as it is not the immediate source of the water supply of plants. The soil is the receptacle of the rainfall and, through the resistance it offers to the descent of water and through capillary action, maintains the water at the disposal of plants. Hence the moisture content of a soil is an essential factor in climatology. Furthermore, as the soils in the same field may differ greatly in their power to retain water, we may have very different climates over very small areas. With forty inches of annual rainfall, the soil may be so open and porous and retain so little moisture that the conditions may be truly arid. We have small areas of truly desert lands in our Eastern States. On the other hand, with only eight or nine inches of annual rainfall, there are some soils so retentive of moisture that they will produce good crops with careful and thorough cultivation.

The general relation of these elements may be expressed in very general terms in the following equation:

$$\text{Sunshine}\left(\frac{\text{Temp.}\times\text{wind veloc.}}{\text{Humid.}\times\text{soil moist.}}\right)=\begin{array}{l}\text{Const. condition}\\\text{of plant growth.}\end{array}$$

This is but an expression of facts perfectly well known to greenhouse men. It will be seen from this that, to maintain constant conditions of growth, any marked change in one of the elements must be followed by a change in one or the other of the remaining elements. Thus, if the temperature rises, the wind must fall or the humidity or soil moisture increase. If the humidity increases, the temperature or wind velocity should increase or the soil moisture should decrease. The sunshine should be recorded by the total intensity rather than by the duration. If the intensity should decrease, the other elements should all be lowered and vice versa. If the above equation holds, it appears that the change in either the humidity or soil moisture or both must be relatively greater than the change in temperature. We have here, then, the principle upon which climatology should be worked out. Given a plant whose pedigree and habits of growth are well known, and a daily range in temperature from 65 to 70 degrees, what range of moisture in the soil can the plant stand? what relative humidity? wind velocity? and what intensity of sunshine? With a certain amount of sunshine, what temperature, humidity, moisture, and wind velocity are necessary to maintain the favorable conditions of growth? This is climatology, and there is no reason why the approximate relation of these elements should not be worked out for different classes of plants and for different periods of their growth.

CYLINDRICAL SUN DIALS.

THE cylindrical sun dial has been known from ancient times. Of the same form as the modern, but more elegant, the ancient instrument consisted of a cylinder upon which were engraved vertical lines that intersected other lines arranged in spirals. The hours were indicated through the shadow thrown by a strip of metal arranged horizontally.

Perrault, in a translation made in 1684 of Vitruvius' ten books on architecture, figures a clepsydra from a description given by that author, and which was invented by Ctesibius of Alexandria, who lived 124 before Christ (Fig. 1). It will be seen from this figure that the dial of this clepsydra is nothing more than that of a cylindrical sun dial on which the hour was marked by a child standing upon a float that rose in measure as the reservoir emptied itself of water. This child replaced the shadow of the style. The author calls such instruments "vertical and portable cylindrical dials."

It is certain that cylindrical sun dials, properly so called, were well known to the Arabs, since their ancient authors often spoke of them.

At Athens, where they were called "heliotropes," they were so common that even the common folk carried them. A proof of this is obtained from the following passage preserved by Athenæus from Baton, a comic poet antedating Ctesibius: "He looks so often at what he carries that one might think that he carried a sun dial."

Cylindrical sun dials were no less well known in western Europe (especially at the epoch of the Renaissance), where they were very richly decorated. We have come across both representations and actual specimens of such instruments belonging to this epoch.

The very remarkable painting of Neuf-Chateau (1520–1600) representing "The mathematician Jean Neudorfer and his son" (Munich Museum) shows one of these suspended as it was intended to be and very well illumined (Fig. 3).

In the Museum of the Louvre the picture of Hans Holbein (1495–1554) representing the astronomer Nicolas Kratzer in his study has, in the midst of mathematical instruments, a cylindrical sun dial, although a very simple one.

Jast Amman (1539–1591), in an engraving upon wood entitled "Astronomy," likewise represents one of them.

The most beautiful ones of the same epoch were of ivory, and were often inclosed in a wooden case (Fig. 2).

The Spitzer collection included one of the sixteenth century, which was doubly curious from the fact that upon the upper part of the cylinder there was a horizontal sun dial accompanied with a compass.

In our collection we have one dating from the seventeenth century and which is of richly carved wood.

These sun dials did not give the time with great precision, but far from it. People were less exacting of old than they are at present, however, and these instruments were considered as all sufficient, and especially as articles "de luxe," and so they were made of precious and carefully wrought materials.

The poor cylindrical sun dials of Bearn that we find at present are more simple, but, even for shepherds, they might be advantageously replaced by our modern pocket watches.—La Nature.

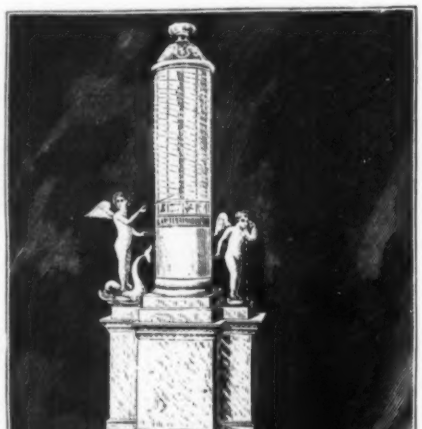


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 1.—CTESIBIUS' CLEPSYDRA. FIG. 2.—IVORY CYLINDRICAL SUN DIAL.
FIG. 3.—CYLINDRICAL SUN DIAL OF NEUF-CHATEAU.

ANIMAL PARASITES.*

ANYONE studying nature will sooner or later discover that animals depend one upon another, or upon certain plants, and also that plants are dependent in turn upon animals. For instance, there is a very rare butterfly in Jamaica, the caterpillar of which is dependent on a certain species of plant and can live upon no other (a great many insects can obtain food from nothing else but a particular plant), and this plant is rapidly disappearing; consequently, the butterfly will soon be extinct.

Parasites are the lowest of the animals in one sense. The different stages through which they pass depend upon the particular species of animals which play the parts of hosts. For this reason parasites are extremely fertile.

Among the most curious parasites are those which live in conjunction with other creatures, but are neither absolutely essential to the welfare of the other: These are called messmates, and may be free or fixed. Of parasites in the old use of the term, there are four different groups: (1) Those parasites that are free during the whole of their life, as leeches, which, though in a measure parasitic, are not true; (2) The group that are parasitic only while young; (3) Parasites that undergo metamorphosis; and (4) Those actively parasitic during their whole existence.

Sea anemones often have messmates, for crustacæ will creep into them for protection. The myxine is more or less of a parasite of the cod, as it bores into the flesh and there lives; this is one of the most marked cases of parasitism among vertebrates. The true parasites are those that in some way injure their hosts and are chiefly found among the invertebrates. The actiniæ kill many fish and are nearly always to be found upon the shell of the hermit crab. Certain small fishes live in the arms of star fish. In Brazil there is a fish which has in its mouth a number of small fry, supposed for a long time to be its young, but now known to belong to a different genus; they simply use the mouth of this large catfish as a retreat in time of danger. Some fish hatch their young in the mouth; in some the eggs are brought out in the gill arches; and in the pike-catfish there is a pouch in which the male carries the eggs until they are hatched. The cuckoo, together with the cow bunting, lay in the nests of other birds, and the eggs are larger than those of the foster parents; and the spurious young, hatching before the others, either throw the eggs or the true progeny out and are thus reared by the foster mothers.

Many crustaceans live upon other fish without injury to the latter. Jelly fish are sometimes accompanied by true fish, and Agassiz mentions one always accompanied by a small species of herring which lives

* Abstract of a lecture delivered by Dr. Benjamin Sharp, Corresponding Secretary of the Academy of Natural Sciences, Philadelphia, at the Academy.

within the bowel of the host, but wanders out in search of food, returning again. The pilot fish and the shark is another case of messmates; but the tale that the pilot fish is of advantage to the man-eating shark in pointing out danger is pure fiction. The remora is a creature of great antiquity, and said to sometimes grow to eighteen inches in length. Pliny declares "if it attaches itself to the bottom of a vessel, it will check it instantly, and the ship will not go on unless this fish is taken off," which is believed by sailors even to the present day. In the Indian Ocean, the remora is employed to catch turtles at sea: A cord is tied through the tail of the remora, and when a turtle is seen the creature is let overboard, when it attaches itself to the first convenient object, such as a turtle or shark. A shark caught at Wood's Holl, Mass., had three remoræ on it, that occasionally they would rest quietly on the bottom, but the instant the water was stirred would immediately dart to their host and attached themselves.

Pinnatheres is a crab that uses the strong shell of the oyster as a home, feeding upon the same food as its host. Pliny, who has some very original and interesting ideas on natural history, says of the oyster: "A certain bivalve is a clumsy animal without eyes. It opens its valves and attracts other fishes, which enter without distrust and begin to take their pastime in their new abode. The fish, seeing his dwelling invaded by the stranger, pinches and kills one after another of his presumptuous visitors, that he may eat them at his leisure." Pinnatheres is found in the water canal of holothurians, and the glass sponge always has one or more; in its early stage the crab gets in through the fine network and there develops, being then forced to remain, since there is no possible way of getting out; and the sponges, carrying in currents of water, bring it sufficient food. Another small crab covers itself over with a sponge, which is of no use, absolutely, except that it serves to conceal from its foes. Still another lives on sea turtles, always on the carapace, and is never found except in midocean. Columbus saw these eighteen days before the discovery of the island of Hispanola (San Domingo), and, supposing them shore animals, naturally imagined he was close to land.

The life history of the common freshwater mussel is interesting. The young have on the foot a long anchor, with which they attach themselves to the gills of the mother, being swept in by the current created by the parent while breathing, and here they remain until of considerable size, when they drop off and develop as full grown bivalves. From the foot of each of these creatures grows a curious hair-like appendage—byssus or vegetable-like moss—by means of which it attaches itself to stationary objects.

Barnacles, such as attach themselves to the bottoms of ships, also make hosts of such cetaceous creatures as whales, porpoises, etc.; they form what is known in nautical parlance as the "hood" of the whale, sometimes accumulate in enormous proportions, and in more than one instance have been mistaken for lone rocks by navigators. The form that attaches itself directly to the whale's head secures nourishment by boring directly into the tissues, until ultimately the host is the sole source of food supply. The young barnacle has a crab-like shape, and a sucker, that is really a prolongation from its back, by which it attaches itself to either an animate or inanimate body. But when the whale is made the host, this sucker is utilized also as a means of penetrating the flesh to secure nourishment, which is obtained in much the same way as does the tree from the soil in which it is planted. Of somewhat similar nature is the "devil's pocketbook" that attaches itself to the turned-under tail of the soft-shelled crab; in its immature stage it is free, but with development it also bores into the tissues of its host, upon whose juices it lives. It is needless to add, perhaps, that the fate of the parasite is then inextricably bound up with that of the crab.

There is another group of parasites that live exclusively upon the waste products and excretions of their hosts. The caligulus is found on the shark, and it is rare to capture one of the latter and not find a number of these lice under the fins of the body; they are as large, perhaps, as a split pea, and move around in a curious, jerky way. They live entirely upon the mucus secreted by the skin of the host.

Before sheep were introduced into New Zealand a form of parrot, known as the Nestor, subsisted exclusively upon fruits and nuts, but latterly has acquired the habit of attacking these useful domestic creatures. They alight upon the back of the sheep and bite through, feeding upon the fat of the kidney, thereby becoming a very serious pest. This is a peculiar perversion of the life habit of an animal of this kind.

Certain leeches always haunt the vicinity of the eggs under the tail of the crayfish and the fresh water lobster, and devour such ova as die or do not develop; they do not touch the live or developing egg. Another form lives upon the eggs of the sturgeon. The bite of the leech, which is regarded as an external parasite, is peculiar. There are three sets of teeth like little semicircular saws, set at an angle to one another, that bore into the skin and make a curious valve. Physicians who employ the leech generally reckon on about as much blood coming out of the wound as the leech itself devours, the cut being clean and sharp and the valves opening outward; there is no stoppage to the blood until it coagulates or clots.

The true parasite always lives at the expense of the host, and may or may not cause the destruction of the latter. By a marvelous instinct a certain form of ichneumon insect selects the tarantula or other large spider as the host for its larvæ. It flies about the great arachnid seeking its opportunity, but the creature is well aware of its danger, and it endeavors to escape or to seize its foe. But sooner or later the inevitable happens, i. e., some ichneumon obtains the opportunity and sinks its sting and ovipositor into the back of the tarantula, which is not killed, but paralyzed. The eggs quickly develop larvæ that feed continually upon the tissues of their host until fully able to care for themselves, then the host dies.

Internal parasites generally reach the economy through the mouth—are taken in improperly cooked food or impure water. Each species of life, generally speaking, has its own particular form of parasite, and there is scarcely a creature in existence that does not at some time in its existence serve as a host. Man, taking him the world over, has an especially large number, no less than sixty being enumerated. One of the most curious and interesting is the Filaria sanguinis hominis, which infests the blood.

Recently it has been discovered that one of the hosts of filaria is the mosquito, which may obtain from and also indirectly convey to man. The mosquito deposits eggs and dies in water, where the filaria undergoes a different stage of existence. This water, when taken by man again, infects him with the parasite. When swallowed, it passes through the walls of the stomach into the circulatory system and begins its life history again. The habit of coming to the surface of the skin when the mosquito is present or during sleep only is inexplicable.

There is another form of filaria, much more dangerous than the preceding, and confined to certain tropical regions. It is known as the Guinea worm, since it was first supposed to be confined exclusively to the Guinea coast of Africa, but is known to likewise infest the West and East Indies, and Guiana, South America. It inserts itself insidiously beneath the skin, is often several yards in length, and seems to move among and through the tissues with the greatest facility. Sometimes it is so close to the surface as to simulate a varicose vein. To remove, it is necessary to locate the head, and by an incision through the skin drag the latter gently out, with sufficient of the body to wind upon a spool or spindle, when it may be gradually extracted; but great care is required to be observed lest the creature, which is loaded with eggs, be broken, in which case a violent, perhaps fatal, inflammation is set up.

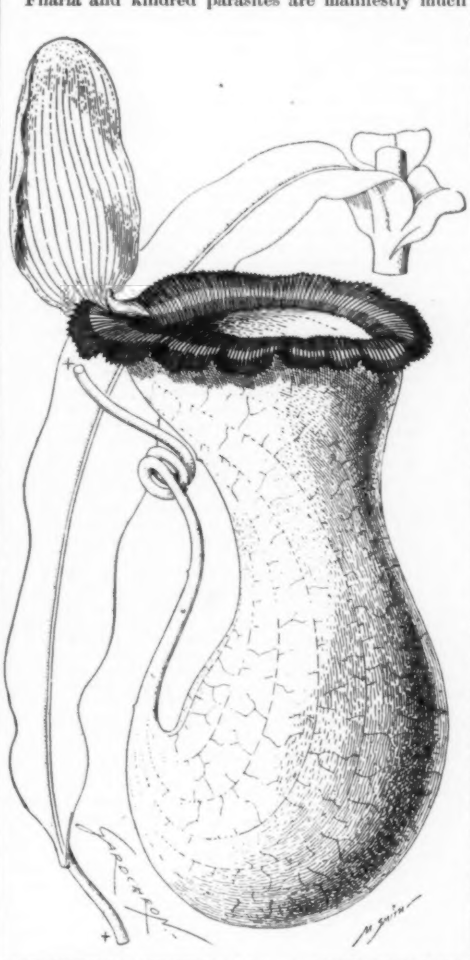
Filaria and kindred parasites are manifestly much more abundant and likewise much more common than are generally suspected. A German physician in one instance, on autopsy, discovered 24 filaria in the lungs; 16 other forms in the tracheal artery; more than 100 in the walls of the stomach; 100 flukes in the intestines; 22 in the esophagus. In one horse over 500 thread worms of one form were counted, 190 of another, 69 tape worms, and 287 filaria. Of the possible dangers from, and also the extraordinary destruction that must accrue to the process of reproduction and development in these forms of life, one may have some slight conception by realizing that a single species during its existence sometimes produces as many as 600,000,000 of eggs; and it has been estimated a single tape worm may be the parent of more than 1,000,000,000. There are tape worms which, however, are foreign to man, that are believed to reach the enormous length of 800 yards.

Study of the tape worm brings up the interesting theme of dual life and alternation of generation. First its egg is covered with a thick, horny shell, impervious to cold and ordinary heat; but the microscope reveals within the egg at least three pairs of hooks. This egg, perhaps, by some means reaches the stomach of the cow or a pig, when the outer shell is dissolved by the gastric juices. Now by the aid of the hooks the embryo works its way through the walls of the stomach and into the circulatory system, and there floats about until it gets into a capillary smaller than its own diameter, when it bores out into the muscle and develops the cysticercus. It is the cysticerci in the muscles of pork or beef that produce what is vulgarly known as "measles." By partaking of this meat raw, or imperfectly cooked, the cysticerci pass into the human stomach, where their outer envelopes are digested, and they turn the other side out like the turning of the finger of a glove, and creatures attach themselves by means of the suckers, or, in some cases, a ring of hooks with which each is provided. Next each cysticercus develops a series of cross sections that enlarge, forming the links, sections, or proglottids of a tape worm.

The head of a tape worm is very minute, and an insignificant affair anatomically, since it is simply an anchor whereby it holds on to its host and gives off hermaphrodite sections ad infinitum, and when ripe these sections are simply sacs filled with millions of eggs. In this way, one stage of the tape worm has to be in one species of animal, and the latter must be devoured by a second in order that the parasite shall arrive at maturity.

In man the two most common tape worms, Taenia solium and Bothriocephalus latus, come from pork and beef respectively, although there are other rare forms had from other animals, such as pike, and Mackinac trout. Curiously enough, the history of the two latter was not known until within recent years; and the Mackinac trout provides the teniæ that infest certain birds of prey. The dog louse supplies the canidæ with a form peculiar to dogs, wolves, foxes, etc.

The liver flukes first appear in the water of ponds and marshes as free, ciliated larvæ, very similar to infusoria. By attaching themselves to the gills or sides of some aquatic mollusk, the snail, for instance, they reach the circulation, when they are known as circaria. The snail sometimes crawls out into the grass and leaves and rests until it is eaten by some herbivorous animal, generally sheep, because in feeding about the sides of the stream these animals habitually devour these shells, when the circaria find their way into the stomach, thence into the circulation, finally securing a resting place in the liver, and there develop into full-fledged flukes, technically known as distomæ. It is notorious that sheep which habitually graze on the highlands never have "the fluke," while those feeding partially on marshes are generally subject thereto. This led to the investigation of the waters of swamps and marshes, and thus the life history of the distoma was finally discovered.



NEPENTHES VENTRICOSA—A NEW PITCHER PLANT FROM THE PHILIPPINES.

NEPENTHES VENTRICOSA.

Two Philippine species of Nepenthes, ventricosa and alata, were described by Blanco in 1837, and have been well known from dried specimens ever since the exploration of that archipelago by Cuming, though nothing has been heard of them in cultivation. A short time ago, however, a plant which had been obtained from the Philippines was sent to Kew by Mr. C. Ford, superintendent of the Hong-Kong Botanic Gardens, and on comparison proves to be N. ventricosa, Blanco. It is a very distinct and striking plant, as will be apparent from the annexed figure. It is apparently more nearly allied to N. Burkei, Mast., than to any other, special points of resemblance being the total absence of wings from the pitcher, and the undulated peristome; yet it differs in shape, in the nearly truncate, not oblique, mouth, and in color, as may be seen by a comparison of the figures. This latter species was originally described as a native of Borneo, but a note by Mr. Veitch in his recent paper (Journ. Roy. Hort. Soc., xxi., p. 237) shows that it also came from the Philippines.

Mr. Veitch remarks: "The late David Burke collected plants and seeds of two species in the Philippine Islands, one of which, a very variable but decidedly beautiful one, we are distributing under his name. Whether these species are the same as those detected by Blanco fifty years earlier is a question yet to be decided." It certainly appears different; and it may be remarked here that Blanco mentioned a third species from the island of Cebu; also that five Philippine species are enumerated in the appendix to the third edition of Blanco's work, which appeared some fifteen years ago.

To return, however, to our figure, we have to note that the pitchers are green, with the peristome rosy red, forming a very decided contrast, though whether the color is fully developed at present is a little uncertain, for those now on the plant have not been formed under the best conditions, and have not reached their maximum development, owing to which the size has been taken from dried pitchers in M. Loher's collection, which, of course, were larger when alive. These dried specimens give an idea of what the plant will be like when well grown, for one branch carries eight splendid pitchers, and others are but little less luxuriant. According to the appendix previously mentioned, it is found in several localities in North Luzon.

It is too early yet to speak of its future as a garden plant, but there is no reason why it should not prove as amenable to cultivation as most of its allies, and owing to its novel shape it should prove a great acquisition, both for its own sake and for hybridization purposes. We may hope that N. alata, Blanco, may yet be added to the list of those in cultivation. Now that a house has been specially devoted to them at Kew, it would be a very interesting matter to see as many as possible of the species cultivated side by side. Nineteen were mentioned as growing there in a recent note in the Kew Bulletin, not to mention hybrids, and it is an interesting circumstance that a striking novelty has been so quickly added to the list.—R. A. Rolfe, The Gardeners' Chronicle.

The lubrication of gas engines has been a somewhat difficult problem on account of the high cylinder temperature that follows the explosion. Not long ago the cylinder of a gas engine used by the Pennsylvania Railroad Company in pumping water became badly scored, owing to the fact that the lubricator was allowed to become dry by the attendant. It was feared that the condition of the engine would require reboring its cylinder, but upon regularly injecting, for a week or so, some finely pulverized graphite through the suction pipe, the engine was found to run smoothly.

Exports from Great Britain to her colonies have decreased about 5 per cent. from 1896 to 1897; exports to India fell off about 6 per cent. A decrease has been recorded for all the important colonies, except Hong-Kong. The imports from the colonies were about 0·75 per cent. less in 1897 than in 1896.—Uhland's Wochenschrift.

THE PREPARATION OF MEAT EXTRACTS.*

By CHARLES R. VALENTINE.

ALMOST exactly two years ago I addressed a gathering of your society here on the subject of the development of the trade of our colonies in dairy produce and the products of petite culture. If I felt some diffidence then, I must confess that I feel more diffidence to-day, because I fear I shall have to tell you a good deal that you know. I will, however, endeavor to do so without being wearisome, and in the hope that I may at least make suggestions that may be of use. I am going to deal with the production and use of meat extracts—so called—and to endeavor to show that Australasia may still further develop a useful and important and remunerative trade in a material that is now the basis of a host of dietetic preparations, the virtues real and fanciful of which are indicated by the advertisements that cover the walls of our streets and fill the pages of our newspapers and magazines ad nauseam.

(1) I will first give some account of the history of meat extracts, and the causes that have led to their manufacture and use.

(2) Then I will treat of the commercial aspect of this manufacture, and give some statistics of the colonies in which I think a very profitable trade may be further developed.

(3) Then I will refer to preparations that are in fashion at present, and their general manufacture and composition.

Perhaps nothing strikes one more forcibly in visiting the great centers of food distribution in England than the changes that have taken place in the last thirty or forty years. These changes appear to be governed by the general rule—"the luxury of yesterday gradually becomes the necessity of to-day." To go back not a very long time, we can trace this evolution in the use of the universal vegetable the potato, and in the abuse of that often harmful and nauseous decoction stewed tea. These are instances of supply creating demand. The booming and advertising of bouillons and extracts of meat has led to something similar in the case of meat extracts, or rather "extracts of beef," all of which have their basis in the product I am about to discuss that is known by its Latin title "extractum carnis." Before dealing with its history, let me say at once that this raw material, the basis of these popular drinks, bouillons, and extracts, can be made in the colonies at a cost that will enable it to be placed on our market at a price within the reach of everyone. Hitherto the price has been quite prohibitive. Popularized in a still cheaper form, it will meet an increased demand, helped undoubtedly by the tendency of the age in this world of rush and hurry that requires everything to be ready to hand, with the minimum of labor and the maximum of quality. Until recently, even in the best kitchens, the use of "extractum carnis" was unappreciated, and the advantages of its application in the making of soups, hashes, stews, gravies, etc., overlooked. There is yet room for a great development in the form in which it is placed ready to the cook's hands, i. e., in clean and easy form for use without being wastefully packed. From another point of view, the manufacture of useful and reviving beverages from "extractum carnis" is to be encouraged as an antidote to alcoholic stimulants which flatter the weak heart "but to betray."

The development of our empire, too, is only now rendered possible by these portable and sustaining extracts. Pemmican and biltong were all very well, but now the question of whether an army corps can reach Coomassie with its available transport service, or whether a forced march beyond Berber, on the Nile, is possible, may depend upon such goods as are known by their epithets, "extract," "condensed," "compressed," etc. Lastly, in the sick room and hospital, the value of a preparation of known strength, purity, and character may mean the saving of life. Scientifically made, there is no fear of a patient being nauseated by the watery infusion that many of us remember we have been compelled to swallow in our sick days of childhood, accompanied with its modicum of dry toast, until the very name of "beef tea" has caused us to shiver. There being this extended use for a good meat extract in the kitchen, in the tented field, in the peaceful scientific exploration far from the base of supplies, in the sick room, and in daily life, as the basis of a useful, palatable, and honest beverage, the corollary follows that there must be an ever increasing demand and popularity. To meet this demand we wish to place Australasia, and especially the cattle-rearing colonies of Queensland and New South Wales, in the forefront.

The idea of concentrating the body of an ox into a thimbleful of elixir must have been a very old one. May be the love potions and philters of ancient and mediæval witches were merely strong bouillons, in which, when beef was scarce, "eye of newt and toe of frog" were used in the caldron! Perhaps, in those days those came nearer to a true appreciation of the physiology of life sustenance who gave their patients raw meat. It must be remembered that meat extracts and concentrated foods are to meet the special circumstances of the sick, and not to supplant but to assist other foods with both them and the healthy. The work of Dr. Justus von Liebig in this respect has hardly met with its due appreciation. Certainly his name appears in various colors on different shaped jars of different preparations, but the light he threw on the physiological action of food, upon its chemistry, and upon the concentration of its valuable constituents, has been forgotten and unappreciated, and, like Pasteur, the bulk of his life's work is overlooked and his name is only familiar to many of us in connection with a minor result of his devotion to study for the benefit of humanity. Be this as it may, Liebig, who died exactly a quarter of a century ago on April 18, laid down certain great principles of the chemistry of food which hold equally to-day as when he enunciated them.

Years before Liebig, the celebrated physicians Parmentier and Proust endeavored to procure a more extended application of the extract of meat; and Liebig, in his "Familiar Letters on Chemistry," published in 1859, quotes them, and shows how Parmentier had pointed out that extract of meat would offer to the wounded soldier a means of invigoration, and, with a little wine, "instantly restore his powers weakened by loss of blood." Proust speaks in similar terms. Now Liebig, ever with a keen eye to the practical when any new scientific truth was elucidated, pointed out fifty years ago nearly that from the continents of America and Australia, where beef and mutton had then only a nominal value, we could, with the simplest means, collect immense quantities of the best extract of meat, the importation of which, he adds, "might perhaps acquire a very peculiar importance for the potato-eating population of Europe." It is equally important with the right manufacture of a meat extract that the public should know exactly what it is, and its true place in dietetics. In touching upon this chemico-physiological aspect of the matter, it must be understood I only give the broad outlines, and that there are modifications of the principles laid down; but for my purpose, and for the purpose of the manufacture of "extractum carnis," these broad principles obtain to-day equally as they did when Liebig first laid them down.

When raw meat is finely chopped and macerated in the same weight of cold distilled water and squeezed out, the water dissolves from 16 to 24 per cent. of the weight of the dry flesh. The fibrine of the flesh is about three-quarters of the solid residue. If the watery infusion be heated, the albumen of the flesh separates as a flocculent precipitate when the temperature of 133° Fah. is reached, and the red coloring matter of the blood, likewise albuminous, coagulates at 158°. The infusion, after being freed by boiling from albumen and the coloring matter of blood, has the aromatic taste and all the properties of soup made by boiling the flesh. This is important to remember in our manufacture of extract. There is no idea harder to eradicate from the mind of the old-fashioned cook or housewife than that the longer she boils meat the more good she is getting out of it. She is a loose observer of facts. She is condensing the extract she has made, but she is only making the fibrinous albuminous part of the meat more recalcitrant than ever. Anyone who has boiled an egg is familiar with the coagulation of albumen, but the cook will not listen to anyone who points out a similarity between eggs and meat. Perhaps, the same spirit that rises superior to a little elementary chemistry inspires the vegetarian and the fasting ascetic with the self-comforting idea that in eating eggs they are loyal to their creed, while beef would be "anathema"! We return to the infusion or extract of flesh from which we have strained the coagulated albumen. This infusion when evaporated at a gentle heat becomes darker colored, finally yellowish brown, and acquires the flavor of roast meat. When it is dried up, there is obtained a brown, somewhat soft, mass amounting to 12 or 13 per cent. of the original flesh (suppose it had been dried). This is in the rough the outline of the process of extract making.

We have rather overrun our ground, and must just hark back to a word or two about food. From the air and soil and the rain, plants, with the sun's aid, build up their structures, and these contain, roughly speaking, two great classes of organic compounds, both necessary to the food of animals. These are (1) the carbohydrates, or non-nitrogenous, such as sugar, starch, cellulose, and the fats; (2) the nitrogenous (albuminoids), such as the gluten of flour, which is vegetable albumen, and the vegetable casein that is found in beans and pease. The plant is eaten by the graminivorous animal, and that animal is eaten by man. There are, of course, mineral matters in the plants which have important functions. You all know that nitrogenous food stuffs are absolutely essential for the well-being of animals, and that without them the animal frame cannot be built up. Liebig illustrated this by calling attention to the fact that from the albuminoids of an egg develop all the parts of the animal body—feathers, claws, membranes, fibrine, blood-vessels, and so on. In the process the albumen disappears. Albumen then, he points out, is "the foundation of the whole series of peculiar tissues which constitute those organs which are the seat of vital actions. The elements of these organs which now possess form and vitality were originally elements of albumen." Albuminoids, then, must be present in every food which by itself suffices to support life. The meat or muscle of herbivora consists largely of solid albuminoids, and hence its importance as food, and it is this difficulty of albumen coagulation that stands in the way of the manufacture of an extract of meat that would be life sustaining by itself. Methods have been adopted to overcome some of this difficulty by the restoration to the extract of the coagulated albuminoids, but in the ordinary "extractum carnis" of commerce the great bulk of the nitrogenous constituents of the meat is absent. If special claims are made for any preparation of it, these claims must be based upon constituents added to it by the manufacturers and patentees of the many preparations, excellent in their way, that are on market.

The great principle to remember in the manufacture of meat extract is that, if flesh employed for food is to become again flesh in the animal body, as few as possible of the constituents of raw flesh ought to be withdrawn from it in its preparation for the table. It is not claimed for "extractum carnis" that it is a food. It is plain that if flesh be simply boiled in water and the meat eaten, much of its constituents have been lost, especially if it be put in cold water at first. It is possible, as I have shown above, to extract from finely divided meat, by the action of cold distilled water, a great deal of albuminous matter, and therefore cooks are warned not to steep fresh meat for long in cold or warm water. On the other hand, washed muscular fiber becomes hardened by boiling it in water, just as does the white of an egg. It is important, therefore, that the cook, if she wants tender meat, should drop it at first into boiling water, and thus form, outside the meat, a layer of hardened fiber and coagulated albumen, which keeps the other juices in the meat, and the albumen among the fibrinous parts inside. The meat should never be allowed to boil hard, but merely to stand and simmer. The effect on fibrine of boiling is, we must all remember, to increase its hardness and toughness. The same applies to the roasting of meat; the exterior should be rapidly heated, to form an envelope, as it were, to retain in the meat the interior juices. This is, roughly, the rationale of cooking, and it will enable my hearers to recognize that beef tea is but a solution of the saline and extractive matters of beef, while the extract made by the Liebig process is an evaporated beef tea containing, in a small volume, the extractive matters and the salts of a large quantity of beef, and in virtue of this, possesses medicinal and dietetic properties not to be despised. Considered alone as a food, it in no sense represents the meat which has yielded it, since it has lost the albuminous element. We will just destroy one other fallacy of the kitchen before passing on to our subject. A cook will judge of the "strength" of her stock by the fact that when cold it was a stiff jelly. Now, as far as nutrition is concerned and life-sustaining power, the thinnest, most watery looking, cold fluid may be of infinitely more value. The jelly is gelatine, differing nothing from any glue or the like extracted from the feet of cattle. Liebig, with other chemists, showed that gelatine itself has little or no dietetic value, in spite of the nitrogen it contains. It will not support life alone, nor will it even replace meat; 50 per cent. of it leaves the body without having helped toward its nourishment, and the remaining moiety goes partly to form fat, or passes away in the form of urea. It has, however, some value in a mixed diet. The cook's gelatinous soup is then not so "good," so "sustaining," as the watery, amber colored fluid made from the maceration of minced raw beef with water. It is to some extent upon the intelligent method of making a true soup that the process of the manufacture of "extractum carnis" depends. Liebig macerated finely divided beef in cold water or water heated up to about 150° Fah. This is evaporated to dryness in a water bath, and forms the extract of beef. From some 32 pounds of lean beef, free from fat and bone, equal to 8 pounds dry meat and 24 pounds water, 1 pound of true extract of beef can be made. Liebig further pointed out that of the true extract nearly 80 per cent. is soluble in alcohol of 85 per cent. In salting meat, the brine that forms contains all the elements of the extract, and you can therefore see what a wasteful plan it is to kill and salt down cattle to export salt beef. Salt beef is not a healthy food, it is bulky to export, and its better qualities have been running away in a useless brine, while the composition of the flesh is changed much more even than by boiling. "Extractum carnis," then, is free from fat and gelatine, while the beef of our kitchens contains both. If "extractum carnis" contained fat it would not keep, but become rancid; if it contained gelatine, it is depreciated in value, for the best dry gelatine is only about half the price of extract of meat.

You will naturally ask what is the value of meat extract, as apparently its qualities, as referred to by me, would seem to be mainly negative, in that I have only said what it does not contain. Liebig saw in it the means of bringing to Europe some part of the food that was wasting at a distance for the want of anyone to eat it. At the time he wrote, lean beef in Australia was worth one halfpenny per pound to nothing; but he meant the extract to be eaten with liberal additions of bread, pease or lentils; that is, with foods that contained nitrogenous constituents, in which the meat extract, by reason of the process of its manufacture, was, of necessity, lacking. To-day in the modern German factory this is being done. The famous erbwurst of the German soldier is pease meal and meat extract with little bits of fat bacon chopped up in it. And let me mention it with some shame—the preserved vegetables the English troops took with them in the last Ashantee expedition were preserved in a German factory, where the meat extract is "strengthened," literally, to-day by the addition of vegetables, pease meal, etc., and made into appetizing and sustaining soups. Thus, to-day, Liebig's idea is being carried out, and now the German soldier is supplied with his meat extract separately, and his pease meal and bacon fat and nitrogenous vegetables to put in it. Vegetable albumen, in fact, is supplied separately to the soldier to put in his extract. At the same time even "extract" with the vegetable albuminoids is not equal to the meat from which the extract is got as a life-sustaining diet.

The exact action of the extract alone is perhaps more that of a useful stimulant, and it is in its development in this direction that there seems to be very great opportunities for its extended use. Its physiological action is not perfectly understood, but seems to be akin to that of the action of the alkaloids of tea and coffee. The lowest and latest mixture—a bouillon made from "extractum carnis"—is retailed to-day at sixpence, and the purchaser is obliged to take more than he requires for one cup or for a single person. In a ready, suitable, neat, and clean form the sale of extract of beef in small quantities sufficient for three-quarters of a cup of hot water should be a successful rival of the popular "pint of four ale." The extract is, in fact, a substitute for flesh when taken with suitable accompaniments, the best of which, I should imagine, would be whole-meal bread, in which the wheat is not robbed of its vegetable albuminoid gluten, as too much of the fine flour is to-day. Popular as are the preparations of extract on the market, we can yet imagine what a wonderful demand might be created if the minds of the people became accustomed to use them, and had them placed before them in small cheap quantities that could be prepared even more quickly, as a beverage, than the dreadful decoctions of our railway refreshment rooms and restaurants called tea and coffee.

If the preparations of meat extract on the market are not legion, they are, at least, a battalion; and I may roughly divide them into four great sections: (1) Extracts by the Liebig process, or modifications of it; (2) bouillons; (3) jellies; (4) juices.

Of the first, we have Liebig's Extract Company "Liebig," blue signature; "Ramornie" Liebig; "Tooth's" Liebig; Baron Liebig, photograph brand; "Brand's" Liebig; Cybels; Armour's Extract (Chicago), modification of the Liebig process; while many large wholesale grocers and warehousemen put up the extract under their own names, and these are all on the Liebig system.

The second class we may call flavored and medicated solutions, such as Bovril, Vimbos, Borthwick's bouillon, Oxine. It is claimed for these that there has been restored to the extract some of the albuminoids that coagulation and straining have robbed it of. These are more of foods, but not so stimulating as the Liebig, because not so condensed. In the case of Oxine it is also claimed by the makers that vegetable matter is added.

The third class, the jellies. These are made by boiling down the gelatinous parts of meat, as well as the lean meat, until a jelly is formed, and this in many cases is fortified by the addition of the extract. In this class (jellies) the well known Brand's essence of beef might be included.

* Lecture before the Society of Arts, London.—From The Journal of the Society.

There are also a number of meat juices, under the names of Armour's, Brand's, and Valentine's. The color of this juice is reddish, which shows that in the preparation it has not been subjected to great heating. The makers claim special methods of manufacture. In some cases the lean raw meat is taken and minced, and an equal volume of water added; it is then squeezed under great pressure, and strained. The juice is then frozen, the water in it freezing out first, the excess of water being separated by a special process.

These are the only four classes of meat extract, and I may say of the first three of them that extract of meat is the basis of all. The popularizing of these essences, bouillons, bovrils, and vimbos, etc., means that there is an increasing demand for extract. There are some "soup squares" made, but they are manifestly largely gelatinous, with starchy and vegetable matters added, together with a small amount of extract. It is also to be borne in mind that a very dark extract is not necessarily a strong one, as the deep color may be due to vegetable coloring matter. The keeping properties of an extract are valuable, and the absence of the albumen has much to do with this characteristic.

There is a meat fluid made which consists of lean meat chemically treated with acid and peptone, by which all the fibrin, albumen, and gelatine are rendered soluble after being digested in water at a temperature of 100° Fah. It is treated with other chemicals to remove the bitter taste, and then evaporated, and as such represents certainly all the lean meat. But for manufacture on a large scale, and from a commercial standpoint, the "extractum carnis" is a more profitable undertaking, in that its manufacture is simple, easily conducted in large bulk, and no somewhat risky chemical treatment is needed for its production.

I think it only proper to refer to Brand & Company, who rank among the first producers of concentrated meats in this country. This house was founded in 1835, by a Mr. Brand, who had for many years been a cook in the kitchen of King George IV. Mr. Brand commenced business upon a modest scale in Little Stanhope Street, and the goods he made a specialty of at first were chiefly patés and edible delicacies of varied kinds, supplied to an aristocratic clientèle. The business continued thus until 1845, when the concern was disposed of to a Mr. Withall, who carried it on upon the old lines until 1861. In that year his friend, Dr. Druitt, urged him to endeavor to perfect and introduce to the medical profession some form of nutriment that patients might take in lieu of medical stimulants, and which should embody the large amount of invigorative power in a small compass. Experiments were undertaken, and the result was the introduction of what is now known as "Brand's Essence of Beef." This preparation has from that time to the present day enjoyed an increasing sale, and Dr. Druitt was its first introducer to the faculty, he bringing it before the Obstetrical Society of London in May, 1861. The "Essence of Beef" and the "Concentrated Beef Tea" formed a nucleus around which other specialties have since been gathered, and from that time onward the house has progressed upon its new basis with remarkable success, playing a most important part in the production of special articles of diet for invalid use. In 1873, Mr. Withall transferred the business to its present proprietors, Messrs. Thomas Deuce and John James Mason, the latter of whom had for many years been the superintendent of the culinary department.

I will deal now with the stock statistics of Queensland and New South Wales. We have no figures relating to the import of extract of meat. It is lumped together with "meat preserved otherwise than by salting," in the Board of Trade returns, and this country pays a bill of £2,000,000 per annum under that head. It is not likely that the trade from the United States will greatly develop, its vast trade in cattle and beef being the line which is more suitable. We paid the United States of America and Canada nearly £10,000,000 for live cattle last year, besides £4,609,000 to the former for fresh beef. The trend in Argentina, too, seems to be toward live cattle and fresh beef export. It is to be noticed, too, that there has recently been a considerable advance in the value of stock in the United States of America, and this concurrently with an increase in number. Let us not forget America's vast resources—in Texas alone there are 1,000,000 more cattle than in the whole of England, and a cow there is only worth from £3 12s. to £4, other cattle being valued at under £3.

In Australasia, in 1895, there were, roughly, 12,000,000 cattle, nearly 7,000,000 of these being in Queensland and 2,250,000 in New South Wales. New Zealand carries over 1,000,000 head, and is increasing her herds rapidly, possessing, as she does, immunity from disease. For the United States of America, 50,000,000 is a moderate estimate; and Argentina must be getting on to 40,000,000, for she had 23,000,000 six years ago, and the development has been rapid. In 1895 Argentina sent to us 12,213 cwt. of "beef preserved otherwise than by salting," the United States of America sent 253,261 cwt. of the same, and Australasia 171,000 cwt.—a very respectable quota indeed. Roughly speaking, nearly all this came from Queensland and New South Wales, in the proportion of two-thirds of it for the former and one-third for the latter. It may just be noticed in passing that figures recently issued show that in 1897 the exports of live cattle from Argentina were 238,121 head, or 144,418 fewer than in 1896. At the same time the frozen beef export increased from 2,997 tons to 4,241 tons. But as there was a decrease of 9,668 tons of jerked beef, as compared with the exports of 1896 from Argentina, the result is that in 1897 the aggregate exports of beef altogether show a considerable decline. Now stock in that country has been much improved by the large purchases of English bulls, and it is apparent that the trade was checked by cheapness here, while probably there has been, by reason of the improvement of stock, an appreciation of value over there. It would appear that Argentina will eventually send the bulk of her beef here as chilled meat of high class. I will place the other beef exports to England of these countries and colonies side by side for the same year:

	Cattle. 1896. No.	Fresh beef. 1895. Cwt.
Argentina	65,708	23,384
United States	393,548	1,649,473
Australasia	32	502,168

Queensland, especially, with her large surplus of cattle, has developed the meat extract trade considerably, and that this is so is largely due to the foresight of Mr. C. G. Tindal and Mr. Tooth, two of the pioneers of the Australian preserved meat industry. The former's name is identified with the celebrated Ramornie brand, and he has latterly devoted much of his attention to the extract trade. From Queensland alone in 1895 there were exported 474,746 lb., valued at £43,000. There is one advantage about the extract trade, too, that I may notice. Tinned and preserved meats have dropped in value by reason of the great development of the fresh meat trade. Extract does not enter into competition with either. It has its own market; it is sui generis; it is the luxury becoming the necessity.

A great many colonists are looking at the trade with longing eyes, and there is something of a rush into it in the colonies referred to because of the manifest advantages. There is all the more danger of the trade being injured by loose methods of manufacture. The trade can no more afford this than could the dairy trade, and it is of the utmost and absolute importance that Australian "extractum carnis" shall earn and maintain the highest character. The utmost care in manufacture is necessary, for one ounce spoiled by burning affects the whole bulk. There must be the latest machinery for cutting the lean meat, hydraulic pressing, perfect cleanliness, perfect command over the temperature of the buildings and apparatus, cleanly and quick disposal of the offal, fat, etc., and no accumulation of the meat awaiting treatment. The beef must be freshly killed, mature, but young beef fed in good condition so as to carry the maximum of lean flesh. Cattle over three years of age and not over four years are, in fact, the best for the purpose, and are those from which the maximum quantity can be made.

The meat is stewed by steam (I use the word in preference to "boiled") in a jacketed vessel, and the concentration of the clear soup is generally done in vacuum pans. Every detail is of the utmost importance. An essential point is the cooling of the meat after killing, and, as in the dairy, a perfect command of the temperature is needed. Meat chopped and laid aside in bulk very soon begins to "change." A first rate extract cannot be made except from the best, cleanest, and sweetest meat. None other but the best is wanted in England. The business lends itself to the co-operative method among stockowners supplying the extract factory, and this especially in the disposal of the by-products. There is all the fat, which has various uses, the meat of the head, neck, etc., the heart, liver, tongue, sweetbreads, blood, entrails, hide, switch, bone, feet, horn, etc., all severally valuable commercially; and on the disposal of these or preparations of them in the rough as marketable commodities, such as glue, tallow, cured skins, charcoal, manure, etc., will depend to a great extent the stockraiser's profits. It is not a trade that any one can rush into, and it must be begun on a perfect system. An ordinary fat bullock gives 400 lb. or so of lean meat, which produces about 10 lb. of extract. It varies in price, and it only pays to make the best. The importance of the by-products will be recognized as a big factor in the commercial success of an undertaking of this nature. In Chicago, where, of course, immense numbers of cattle are slaughtered, the by-products are turned to the best account in a systematic way, and the exporters even of the primest beef depend largely upon these for their profits. The skin of the head with that of the legs and tail goes to the glue factory; the cheeks are used for bologna sausages; the tongue is pickled and smoked; the skull goes to the glue house and is boiled, and then to the fertilizer factory; the feet make glue and neats-foot oil, and the bones of them go for tillage; the sweetbreads are used to make pancreatin; portions of the liver and heart are used for sausages; the blood goes to the maker of fertilizers; and the horns are made into knife handles, buttons, and combs. It is through the saving and utilizing of absolutely every portion of the bullock that the packer can make his business pay as it does; and as an example of the completeness and economy with which all by-products of thousands of stock are utilized, I cannot do better than refer to Mr. P. D. Armour, of Chicago. At Armour's works this utilization of by-products is carried to perfection. There is absolutely no waste. The country butcher in England, who kills two bullocks a week, lets more run to waste than is lost in the disposal of 100 head at Armour's.

The first samples of extract that came from Australia were very good, but as new packers rushed into the trade, a deterioration was noticed, due to improper treatment and careless selection of the meat, and to the neglect to expel all the water, or carelessness in heating and consequent burning. The latest appliances of mechanical skill must now be used as in the dairy, and rule of thumb and guess work must give way to science and exactitude. In the best constructed and managed works in the colony, every care is exercised in the selection and treatment of the meat, and where the rough and ready idea of slumping any kind of stuff on to the market has been prevalent, it is luckily killing itself by the inexorable logic of £. s. d., for the margin of values between the best and the very ordinary extract means a price either of 4s. 6d. or 2s. per pound.

The next essential to absolute cleanliness is the necessity of getting the whole of the animal heat out of the fresh killed beef. The cooling chamber is a necessity and so is the regulation of the temperature of the manufactory in which the manipulation of the meat takes place. The age and sex of the animals has a good deal to do with the quality of the extract, preference being given to bullocks three years old or a little over. It has been found that at this age the yield of extract is the best; below that age or above it, the best results are not generally obtainable.

Of course, extracts can be made from veal and young animals, and with proper care they are not too gelatinous, and are nice for a change of diet.

The meat being properly cooled, it is jointed and the flesh cut into cubes, and it is important that at this stage it should not be allowed to remain long heaped up in great quantities, or a taint will develop. In 1867 Dr. Thudichum, at a meeting of the food committee of this society, explained the principles that make this important. The coloring matter of the muscles is called myochrome, and is identical with the coloring matter contained in the blood. Dr. Thudichum pointed

COMPARATIVE ANALYSES OF VARIOUS FORMS OF EXTRACTS OF MEAT.

	Liebig's Process or Modifications.	Bouillon.	Meat.	Jellies.
Water	16·54	29·14	89·15	51·80
Sodium chloride	3·11	14·12	0·26	7·50
Other salts	19·63	3·38	1·04	
Organic matter	60·72	53·36	9·55	40 70
In the Organic Matter.				
Albumose	22·62	28·60	4·00	7·0
Gelatin	0·25	0·56	1·71	13·0
Flesh bases and decomposition products	37·85	24·10	3·84	14·8

out that this aids in the breathing of the muscles during life, and some time after death. As long as the meat is in an eatable condition this matter remains, so to say, alive. Hence a butcher takes care to let his meat "breathe." If the meat were shut up close after being killed, it would become putrefied in a few hours. Piled-up, the big heaps of imperfectly cooled minced beef would soon develop taint. The cubes of meat should be uniform in size, and this is now cut up by machinery. The meat is then put in a jacketed boiler, as I have said, with its own weight of water, the heat being raised to 175° Fah., and it is kept stewing for about twenty minutes. It requires constant attention and stirring to prevent any possibility of burning, and the regulation of the heat must be nicely adjusted.

It is then taken out and strained, the residue is pressed and squeezed and the liquid put into a vacuum pan, and concentrated down to the desired mass, a brown, pasty substance containing from 13 per cent. to 16 per cent. of water. If cooked too long in the first process, and if the albumen is not carefully strained out after coagulation, the extract will contain more moisture and the presence of albumen will deteriorate its keeping properties. The pure extract is wanted, and not a stocky, sticky, gelatinous mass. In some cases the mass, after being heated, is put into bags and the whole of the liquid pressed out by hydraulic or heavy pressure, so that the residue left is like nothing more than a piece of blotting paper or gun wad. There is little doubt that the latter system is the best, for the extract then contains the full forces of the meat, whereas by the straining process a good deal is left in the residue. Some works have been rather chary, however, of adopting the latter method through fear of too gelatinous and "stocky" extract resulting. Stocky extracts are not wanted in England, and can always be made here, as they are done, in the form of jellies and soups, to which extract is added. The reason the meat is not kept at a high temperature for a long time is to prevent the decomposition of the gelatinous matter in the fiber and its inclusion in the extract. Extracts (as shown in the table of analyses) should generally consist of about 16 per cent. water, 53 per cent. of extractive soluble in alcohol, 13 to 14 per cent. of extractive insoluble in alcohol, and 18 per cent. or more animal matter. The extract consists of inorganic and organic substances, the former being chiefly and generally alkaline phosphates and chlorides—chiefly phosphate of potash and chloride of potassium, with possibly some ammonia as the base of a phosphoric acid compound. The organic parts of the extract are creatine, or creatinine, and gelatinous extractive. A good extract should always have an acid reaction, its color should be a characteristic yellowish-brown, and it should have an agreeable meat-like odor and taste. It should be entirely soluble in cold water, and should be free from albumen, fat, and gelatine.

The big centers of the manufacture of extract of meat are Chicago, Buenos Ayres, Queensland (Townsville, Rockhampton, Gladstone, Bowen, Brisbane), New South Wales (Ramornie), Sydney (Meat Preserving Company), New Zealand (Hawke's Bay—Nelson Brothers). The practical methods of manufacture are broadly on the same lines everywhere, but each center has some little plan or convenience in operation that has been discovered in actual working, and formed the basis of some invention. A South American factory consists of a large, cool, dark, flagged hall kept scrupulously clean. Here the meat is weighed and passed through apertures to the meat-cutting machines of special design, that can get through an incredible amount of work. Hence the meat is passed into digesters, which hold about 12,000 pounds each, and it is "digerated," as it is termed in a description of the commercial Liebig process, by high pressure steam, 75 pounds to the square inch. The liquid is then run to a series of fat separators. Here the fat is separated in a hot state because no time can be lost in cooling it for that purpose, as decomposition sets in so very quickly. In clarifiers below the separators the albumen and fibrin are coagulated out, and the liquor then runs into large evaporators, where vacuum evaporators evaporate the extract at a very low temperature, the liquor being filtered several times before it is run into the evaporators.

In Bovril, we are told by the founder of this convenient form of putting up beef extract with other things, Mr. J. Lawson Johnston, that he hit upon a system of adding the albumen and fibrin to the beef extract in the form of a desiccated powder. Probably the success of this bouillon as a popular beverage was mainly due to the fact that for the first time the public were enabled to buy a cup of decently made and invigorating beef tea cheaply over the counter. "Johnston's Fluid Beef" found much help in its sale at first, owing to the Scott Act in Canada, and a hot cup of Bovril was no mean substitute for hot spirits when the sale of alcoholic drinks was prohibited. Others have followed in the wake of Mr. Johnston, and have adopted packages which are similar in appearance and cannot help but be looked upon as a colorable imitation of the first popular bouillon on the market. It is rather a pity that the inventors of similar preparations

have not struck out a new line in the shape and style of bottles and jars.

The slaughter of cattle on the River Plate and Rio Grande districts is about 2,000,000 head annually. The South American process is briefly much that which I have described above. The arrangements for slaughtering the cattle in great numbers and for dressing them with the utmost dispatch are very complete and the meat used is carefully selected. The basis of Bovril and other bouillons is, as we have said, the extract of beef. It is claimed, however, for this and other mixtures that the elements that coagulate in the liquid extract are restored with the manufacture of the finished article in England, and that the dried albumen and fibrin are sent over in hermetically sealed tins and worked back into the mixture here.

It is significant of the even greater development which may await the Australian trade that many of the large manipulators give preference to the finest Australasian extract, as it possesses a greater fullness and, if anything, a finer flavor than the South American.

THE ART OF TAXIDERMY: MOUNTING LARGE MAMMALS.*

As soon as possible after a skin is removed from the carcass, all blood should be carefully sponged and combed out of the hair, and any surplus flesh that may adhere to the skin shaved off with the knife; then it should be salted, common table salt being preferable (and plenty of it), although rock salt pounded up fine will answer.

A skin should be scraped or fleshed a day or two after salting, as the fat, etc., comes away much easier at this stage than at any other time, the salt having hardened the tissues so that the knife will take hold.

Small skins may be scraped with the hand scraper, and the skin itself shaved down with a shoe knife, using as a beam a small half round piece of wood screwed fast to a bench or table so as to project horizontally. For larger hides this process of removing the flesh and fat is improved upon by using the tanner's moon knife and stretching frame. The moon knife is simply a circular steel blade clamped to a crutch-shaped handle of wood, the crutch fitting under the arm-pit, so that the entire weight of the body may be thrown on the skin if necessary. The stretching frame consists of two uprights connected by a crossbeam and a second crossbeam hinged at one end, and arranged to clamp tightly upon the first with the aid of a lever.

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TANNER'S STRETCHING FRAME.

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FLESHING A SKIN.

The skin is placed in the stretching frame and the fat and flesh worked off with the moon knife. The head, tail, and feet are roughed off with a shoe knife. Instead of the frame and moon knife, on tough skins the large fleshing knife and upright shaving beam are used for this purpose.

The skin, if saturated with grease, should now be well washed in water containing a little washing soda, and after being wrung out placed in benzine for an hour or so. The skin is then removed and hung up to dry, and then placed in tan liquor (one ounce of sulphuric acid to one gallon of water in which one quart or more of salt has been dissolved), where it may remain until wanted, be it one day or one year. For the first few days the skin should be moved about and its position changed, so as to give the liquor a chance to operate on every inch of the inner surface. If it is preferred to keep the skin in a dry state, which is recommended if it is not to be mounted for more than a year, it may be taken out, washed, painted on the inside with arsenical soap, dried, and stowed away for any length of time.

One secret of success in fine mammal taxidermy is to have the skin shaved down from the inside as thin and smoothly as possible. In this process the skin is thrown over a smooth, half cylindrical beam of hard wood, tilted up at an angle, the upper or free end coming about to the middle of the body of the operator. The currier's knife has a blade on either side, made detachable, with the edges turned over like a carpenter's steel wood-scraper. The knife works after the manner of a plane, cutting off a shaving at each stroke, thicker or thinner, according to the depth of the turned edge. With this tool it is just a question of time to reduce a skin to any required degree of thinness. Most skins shave the best a day or two after having been salted and before going into tan liquor; but they may, of course, be shaved at any future time, while wet or damp. When dry, or nearly so, if it is desired to get a skin as thin as paper, provided it will stand it without injuring the roots of the hair and causing the latter to fall out, sandpaper placed over a block of wood may be used, and the skin sandpapered down as thin as desired. An emery wheel is, of course, better than sandpaper. After shaving, or during the process, a skin may be placed in and taken out of tan liquor repeatedly. Before putting a skin on the manikin it should receive a thorough stretching on the frame with the crutch and moon knife, if at all a tight fit. A skin which requires more stretch will be found to relax still more after coming out of the tan liquor if placed in soda water for a short time.

Salted skins of large mammals will relax readily when placed in water or tan liquor, and when beamed and stretched are ready to mount. Skins which have been simply dried without previous salting require to be placed in clear water or in damp sawdust until they collapse; they are then scraped on the inside, or as much of the inside as it is possible to get at, when the skin is placed in tan liquor to complete the relaxation. If left in clear water too long, the skin will macerate and the hair fall out. A dry skin will, of course, relax in tan liquor alone, without the previous soaking in clear water, but it takes a little longer.

After the final beaming, the skin is taken from the tan liquor, wrung out, thoroughly washed in lukewarm water containing a little washing soda, and the salt well rinsed out; the skin is next wrung out again, and placed in benzine for half an hour, care being taken that no fire is near, then wrung again. Now furrier's sawdust is placed in a tray and the same well worked into the fur, when the skin is shaken out, beaten with rattans and again placed in the tray, the process being repeated. This is done over and over again until the hair is bright and clean. Note, however, that the sawdust must never be used on wet fur without the intervening bath of benzine; else it will cling to the hair like plaster, and can never be got out. All skins covered with hair or fur should be treated in this way before going on the manikin—the term "manikin" is here applied to the modeled form or dummy figure of the animal, which is as nearly as possible an exact counterpart of the carcass of the creature after the skin is removed.

In preparing the manikin, the dry limb bones (attached at the joints by their ligaments) are placed in warm water until the ligaments are sufficiently relaxed to permit the joints to move readily, when all superfluous flesh and sinews are removed with a knife. The lower bone of one hind leg is clamped in a vise, and with the aid of a surgeon's saw and carpenter's gouge the back is grooved out to admit the iron rod which is to be used to support the manikin. Passing on the inside of the hock bone or calcaneum, the lower part of the tibia (just above) is also gouged out in the same way; otherwise the rod will be in the way when the skin is clamped tightly together between the great tendon and the bone; at this point the opposite sides of the skin of the leg actually meet, and the rod must be kept out of this place at all hazards. The other hind leg is similarly treated; also the front legs from the bottom to just a little above the knee joints. Four pieces of the best Norway iron rod, of proper thickness, are now cut long enough to allow of coupling to the center board above, and below the hoofs for attaching to the pedestal. The size of the rod will be governed in a measure by the bulk of the animal, but more especially by the thickness of the shank bone, and a thread for a nut is cut on each end; and the rod must also be carefully bent to conform to the leg bones.

The pelvis, cleaned of all flesh, is nailed fast at the proper angle to the center board—a piece of pine seven-eighths of an inch thick, and long and wide enough to represent a section straight down through the center of the animal's body. The hind legs are now attached, so that their articulating surfaces meet those of the pelvis, the rods being bent to pass through the center board, where they are solidly fastened. If the heads of the femurs fit snugly into place in the sockets of the pelvis, and the latter is properly adjusted, the rear part of the animal is obviously correct in height and width.

The measurements taken from the animal when in the flesh are now looked up. The distance from the head of the femur to the head of the humerus on the same side is marked off on the center board; also the distance between the outsides of the heads of the humeri, thus giving the width of the chest, and the tops of the leg rods are bent and coupled in accordance, care being taken that the elbow comes at precisely the exact point with reference to the brisket that the measurements call for. Next a temporary pedestal is constructed of seven-eighths inch pine boards, with a cross-piece underneath each end, about three inches in height, nailed fast.

Now the leg bones by their rods, duly attached to the center board, are adjusted on the pedestal in the precise positions they are to assume in the finished specimen. The rods are made to come down perfectly straight, from every point of view, and the hocks are well thrown together. The nuts are now run up on the bottom of each rod as far as the thread will permit it to go, and having been provided with four legs, the beast is made to stand up. The frame of the manikin now stands alone, and, if properly done, remains firm and rigid.

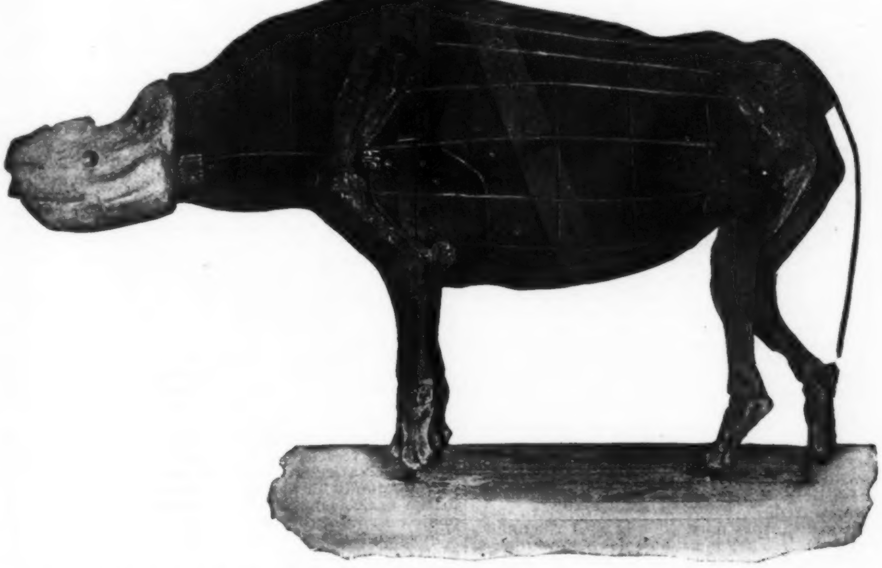
If the manikin at this stage looks as if it were going to fall over forward or backward, the finished specimen will look the same. The center body board is now marked off and trimmed down until it represents exactly a section of the body down through the center. The skull is next fastened on, having been prepared by having a longitudinal slot two inches wide (more or less, according to size) sawed in its base underneath, and a block of wood (made to fit the cavity and previously bored to receive a suitable iron rod) inserted; the block is held in place by screws running into it above and behind. The rod to connect the skull and center board is cut of sufficient length for the neck, bent at the proper angles, and duly fastened.

The skin is now tried on, to make sure it is not too large. It should meet across the chest and around the belly, with room to spare. The hoofs also should rest easily on the pedestal. The distal ends of the limb bones are raised or lowered by shifting the nuts on the rods. The center board must be exactly in the center of the body, and this may be determined by the aid of a plumb line. If the head is in proper position, a second rod is placed alongside of the first neck rod, and also made secure to the skull and the center board.

Having proceeded thus far, annealed iron wire netting or wire cloth of moderate mesh is made to envelop

* From the "Art of Taxidermy," by John Rowley. D. Appleton & Company, N. Y., 1898.

the entire center board, taking in the pelvis, thighs, and shoulders; it is tacked fast along the top of the center board with small wire staples or nails, and, by cutting with snips and fitting, it is adjusted as nearly as may be to the form of the body and upper limbs and tacked fast along the underside of the body board. The netting is held in the natural hollows behind each fore leg and in front of each hind leg by drilling holes through the center board at these points, passing a wire from one side of the netting through the holes to the other side and twisting the ends. The netting is, moreover, tacked and wired wherever necessary until



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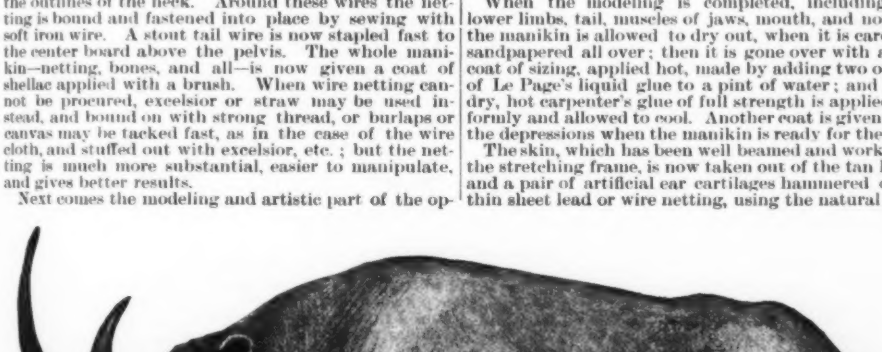
INTERIOR MECHANISM OF MANIKIN FOR A RHINOCEROS.

the body and upper limbs are built out, generally, to their proper form. The skin is now again adjusted and fitted closely all over the manikin and all defects remedied wherever necessary. When the netting is all adjusted on the body, the neck is attended to.

Two stout wires are cut, one to run from the top of the skull to the top of the center board at the shoulder and the other from the palate to the brisket. The wires are stapled fast to the center board and bent into the outlines of the neck. Around these wires the netting is bound and fastened into place by sewing with soft iron wire. A stout tail wire is now stapled fast to the center board above the pelvis. The whole manikin—netting, bones, and all—is now given a coat of shellac applied with a brush. When wire netting cannot be procured, excelsior or straw may be used instead, and bound on with strong thread, or burlaps or canvas may be tacked fast, as in the case of the wire cloth, and stuffed out with excelsior, etc.; but the netting is much more substantial, easier to manipulate, and gives better results.

Next comes the modeling and artistic part of the op-



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FINISHED RHINOCEROS.

eration. The whole surface is given a thin coat of papier maché, made by mixing mushy, wet, paper pulp with sufficient dry plaster of Paris in twenty ounces of warm water, to which a teaspoonful of hot glue or Le Page's liquid glue has been added. This is applied with a spatula or flat modeling tool, and while soft smoothed by brushing over with a wet brush.

The tendo achillis is represented by drilling a hole into the top of the calcaneum, inserting the end of a stiff wire into the hole, and bending it over until the upper end rests upon the papier maché of the thigh; a second wire is bound fast underneath the first to stiffen it, and then both are wrapped tightly with wisps of tow to act as foundation for the papier maché. After the papier maché has set, the tendons of the forelegs may be cut in with a knife.

If a live animal of the species being mounted is available, every opportunity should be taken to study its anatomy and to reproduce the anatomical outlines on the manikin; but if such opportunity does not present, good photographs and casts of parts may be followed and the details worked out.

Any amount of labor may be expended in modeling a manikin. The skin should be, wholly or partly, adjusted frequently to see what effect the underlying material is going to give when it is put on permanently. If the skin will not cover the model, it may be due to one or two causes—either the manikin is too large or the skin has not been sufficiently shaved down. Details are, of course, governed by the length of the hair on the skin, it being obviously unnecessary to reproduce every muscle and wrinkle, the same to be hidden by six inches of fur.

When the modeling is completed, including the lower limbs, tail, muscles of jaws, mouth, and nostrils, the manikin is allowed to dry out, when it is carefully sandpapered all over; then it is gone over with a thin coat of sizing, applied hot, made by adding two ounces of Le Page's liquid glue to a pint of water; and when dry, hot carpenter's glue of full strength is applied uniformly and allowed to cool. Another coat is given in all the depressions when the manikin is ready for the skin.

The skin, which has been well beamed and worked on the stretching frame, is now taken out of the tan liquor and a pair of artificial ear cartilages hammered out of thin sheet lead or wire netting, using the natural cartilages, which have been skinned out of the ear and soaked up in hot water, as models. All holes in the skin are carefully sewed up from the inside, using a glover's needle and stout thread waxed with beeswax, sewing from within outward, with what is known as the "ball stitch." All seams are afterward flattened by hammering them on a block of wood. Much nicety can be displayed by sewing up cuts and holes.

In a thinly haired skin the needle should go but part way through, thus bringing the edges together without any stitches showing from the outside. If a piece of the skin has been cut out bodily, two V-shaped cuts are made on opposite sides of the hole, the pieces taken out, and the edges, now enlarged to a straight cut, brought together. Sometimes, provided it does not interfere with the color pattern of the hair, where a round hole exists and there is no surplus skin to spare, but one V-shaped piece is cut out at one side of the hole, and the base of the V-shaped piece set back so as to occupy the space and sewed in place. On a short haired mammal, sometimes the edges of cuts and holes are not sewed together at all, but simply made to meet on the manikin, when they are glued and pinned.

The hide, having been washed, rinsed in benzine, and thoroughly cleaned with furrier's sawdust, as before described, is laid flat on the floor and well painted on the flesh side with a solution made by dissolving a pound of white arsenic in 20 ounces of water. Next the lead or wire-netting cartilages are given a thin coating with papier maché, made by mixing 10 ounces of well squeezed out paper pulp, 3 ounces of hot carpenter's glue, and 20 ounces of plaster of Paris; and while this is soft it is painted over with liquid glue, or hot carpenter's glue, and the cartilages shoved into the skin of the ears and carefully adjusted; also a few stitches are taken through the ear from the inside to the outside and passing through the lead, to keep the skin from shifting during the subsequent manipulation. The butts of the ears and the feet are now filled with papier maché. The phalanges may be entirely removed and their places supplied with the composition. By this process a foot may be more easily modeled into shape than by leaving the bones attached to the hoof.

The skin is now placed upon the manikin for the last time. It is a great advantage to have two or three persons at work on a specimen at this stage, as the skin dries rapidly, and water applied to soak it up is liable to so soften the underlying glue as to destroy its sticking qualities.

The skin is placed in position at all points, and the legs sewed up, beginning at the hoofs. The glue on the manikin offers a slippery surface upon which the skin may be worked in any direction. If too much skin is found at certain points, the surplus may be worked away and distributed over the manikin. If a stretch is required, the skin may be pulled from any direction, the operator feeling assured that by so doing he is not altering the form of the hard manikin. After the legs are sewed up, the belly cut is treated in the same manner. The ears are adjusted and made to stand in any desired position by stuffing in pads of tow and papier maché mixed, through the opening of the ear, with a pusher; stout pointed wires are also driven into the skull through the ear openings, the ears thus held in position till dry, when the wires are withdrawn. If any fine wrinkling or modeling is to be done from the outside of the skin, papier maché is introduced between the skin and the manikin and worked with a modeling tool.

When the skin is properly adjusted upon the manikin and all sewed up, dry sand is heated and placed in small bags, the sand, of course, not being heated enough to burn the cloth. A hot sand bag is placed against the skin in all depressions of the manikin and held there until the underlying glue is liquefied. The skin at this point is smoothed out with the fingers, and if perfectly loose will need nothing further to hold it there for all time. In places where the skin is inclined to draw away from the manikin by reason of tightness, in long-haired mammals, after the sand bag is applied, it is clamped tightly to the manikin by means of pins driven in with a tack hammer; in short-haired animals, strips of leather, one side covered with hair a quarter of an inch long, to act as a cushion, are cut to fit and pinned fast, hair side in. If great smoothness is desired, the hot sand bags may be used all over the specimen—the cool bags, of course, being changed for the hot ones during the process. The object of pinning the skin is to hold it down upon the manikin until the skin and the underlying glue become dry, when the pins are withdrawn, leaving the skin stuck fast.

The lips are modeled by introducing papier maché under them, and pinning in place. The artificial eyes generally manufactured for taxidermists' use are much too flat, and the white corners are raised too far up on the convex side. Half globes, painted on the inside with tube colors, using the natural eye as a model, are the best that can be procured. But mammal eyes, made in the ordinary way, without the white corners, answer very well, if the corners are subsequently worked up in wax and varnished after the lids are dry. When the artificial eye is inserted, the sockets should be filled up with papier maché, and the upper lid drawn well over it. Care also must be taken to properly adjust the eyelashes, as these hairs project downward rather than upward, as is generally seen in mounted specimens. The lids are painted with lampblack, mixed with water, to get the expression of the eye temporarily.

Finally, the hair of the entire specimen is to be carefully adjusted with a steel comb. When well pinned, any everything complete, it is set away to dry.

In mounting mammals by the foregoing process, as much necessary detail is worked in upon the manikin as possible. The interior mechanism of a rhinoceros manikin is shown in one illustration, the finished specimen in the other. The skin alone of this specimen weighed 270 pounds, but when shaved down and wet, ready to clothe the manikin, it, including feet and all, only weighed 27 pounds. All the folds were modeled upon the manikin, and the skin afterward glued fast as described.

Aluminum is a source of stored energy whose use, as described by Herr Goldschmidt to the German Electro-Mechanical Society, has given astonishing results. When mixed in a sand-lined wooden bucket with an oxygen compound, such as iron oxide, the aluminum can be ignited with a match, after which it burns quietly, giving forth an intense heat, which may reach 3,000° Centigrade. This supplies an economical furnace for brazing or hard soldering. It can be used also for welding, for producing pure wrought iron, for making a variety of alloys, and for obtaining certain pure metals free from carbon that have been hitherto almost impossible to produce. A mass of metallic chromium weighing fifty-five pounds has been obtained in this way. The slag is of interest, being artificial corundum of extraordinary hardness and containing minute artificial rubies.—Boston Transcript.

ENGINEERING NOTES.

F. A. Delano, in a recent paper before the Western Railway Club, showed that merely changing from gravel to cinder ballast, and increasing the weight of a locomotive 15,000 pounds, increases the strain on the base of the rails from 10,450 pounds to 13,810 pounds, a difference of 3,360 pounds, or an increase of 32 per cent. The removal of a tie from a track laid with a 66-pound rail supported on oak ties and gravel ballast increases the strains produced by an engine weighing 125,000 pounds from 13,810 pounds to 16,430 pounds, an increase of 2,620 pounds, or 19 per cent.

The International Association for testing materials, at the Stockholm Congress of 1897, declared it expedient that the members of the association resident in any one country organize themselves into a body for better carrying out the purposes of the association and simplifying matters of correspondence and finance. A meeting was called for the purpose of effecting the organization of the American section, at Philadelphia, on June 16. Mr. Gus C. Henning, M. Am. Soc. M.E., and member of the council of the association, has been appointed the provisional American representative of the association.

The cost of broken stone for building roads is not so great as many suppose. It can be bought at the crushers for 40 cents per solid yard, and the railroad will freight it forty miles or less at about 50 cents per cubic yard, making a total of 90 cents; but suppose we call it \$1. Then, if the roadbed is nine feet wide and the stone is piled on a foot deep, a cubic yard will cover three feet linear at a cost of \$1, making one mile (1,760 yards) cost as many dollars. But as only about nine inches are necessary, one-fourth of this amount, or \$440, should be deducted, making the exact amount only \$1,320, which is cheap enough for a first-class road, the material for which must be brought forty miles by rail.

The U. S. S. "Buffalo," formerly the Brazilian dynamite cruiser "Nietheroy," is at the Brooklyn Navy Yard, to undergo extensive alterations. This vessel was originally "El Cid," of the Morgan Line of steamers, and she was built by the Cramps, of Philadelphia, about 1892. In October, 1893, she was bought by the Brazilian government and greatly strengthened in her decks and armed with a 15-inch dynamite gun, one 55-pounder and two 33-pounder rapid-fire guns, and eight 6-pounder and nine 1-pounder Hotchkiss guns. The length of the ship over all is 406 feet; draught, 23 feet; displacement, 4,666 tons; coal bunker capacity, 1,000 tons, and 2,000 tons more can be carried in her hold. The "Buffalo" will be fitted with a 3 to 2-inch steel belt, and she will carry a main battery of ten 6-inch rapid-fire guns and a secondary battery of 3 and 6-pounders. She was designed by Mr. Horace See, M. Am. Soc. M.E., then with the Cramps, and her speed was 17½ knots per hour.

An air compressing plant recently installed at the Alaska-Treadwell Mine, Douglass Island, Alaska, includes what is said to be the largest Pelton water-wheel in the world, says The Practical Engineer. In this installation a duplex Riedler compressor with 24-inch cylinders is driven by a horizontal cross-compound condensing engine, with 24-inch and 36-inch cylinders and a 36-inch stroke. The steam cylinders are placed behind the air cylinders, and the piston rods are provided with couplings. Instead of the usual flywheel, a Pelton water-wheel, built by the Pelton Water-wheel Company, of San Francisco, is mounted on the compressor shaft. It is 22 feet in diameter, weighs 25,000 pounds, and will, when running under a head of 480 feet at its normal speed of 75 revolutions per minute, develop 500 horse power, delivering 28,000 cubic feet of free air per minute. The largest wheel previous to this is operated by the North Star Mining Company, Grass Valley, California, and is 18 feet 6 inches in diameter. When from any cause it becomes necessary to shut off the water, the piston rods are connected and the engine is started.

Ironfounders are usually well aware that a certain loss is incurred in the melting of iron in a cupola; but there is little available data to guide them as to the average percentage that is lost. A careful furnaceman will always see that he puts in just a fair amount of iron over and above what is required to fill the moulds; and on the accuracy with which he judges the amount without undue waste, is the skill of the cupola man indicated. If he is using much scrap of a nondescript character, he will find it necessary to be more liberal in his allowance for waste. Mr. Thomas D. West has recently made some experiments in the melting of sand and chill castings, as well as on those protected with various coatings, in order to ascertain with some degree of accuracy the loss of cast iron by oxidation; and he gives the result in a paper read before the Pittsburg Foundrymen's Association. It was found that the sand castings oxidized in melting to a greater extent than either the protected or unprotected chill or sandless castings. The average losses were: Sand iron, 5·8 per cent.; sandless iron, 3·4 per cent.; chilled iron with lime wash, 3·8 per cent.; with graphite wash, 3·4 per cent.; with silicate of soda wash, 2·9 per cent.

Before the Congress of the Maritime Association, which met at Paris, in December last, under the presidency of De Bussy, Laubeuf read an interesting paper on the influence of the depth of water on the speed of vessels. Of the various experiments made in England by the cruisers "Blake" and "Blenheim," in the United States by the "Columbia," "Brooklyn," "Minneapolis," and "New York," and in Denmark by the torpedo boat "Mackrelen," Laubeuf considered the latter as most instructive, because most complete. The depth varied in this instance between 14 feet and 50 feet, and the boat was steaming on an average at 14 knots; the speed was influenced to the extent of 4·5 knots. The curves have sharp points and cross one another, showing that the depth of the water is, of course, not the only feature to be considered. Laubeuf has given formulæ for the lowest depths, favorable for certain types of ships. He calculates, e. g., that the "Minneapolis" and "New York" should have 115 feet of water, which they could not find near Brest and Cherbourg, for experimental purposes. He confirms the observation made by Vechourtzow and also at Stokes Bay that some small ships run faster in shallow water.

MISCELLANEOUS NOTES.

The number of factories in Russia has increased more than thirteen-fold from 1850 to 1890, and, in the same period, the value of manufactured products has increased more than one hundred-fold.—Uhland's Wochenschrift.

Dr. Auer von Welsbach has taken an Austrian patent for a filament for incandescent electric lamps. This filament consists of osmium, sometimes alloyed with other metals of the platinum group, and in some cases an osmium or osmium alloy core receives a coating of thorium oxide.—Revue Industrielle.

The largest map in the world is the Ordnance Survey map of England, containing over 108,000 sheets, and costing \$1,000,000 a year for twenty years. The scale varies from 10 feet to ⅛ of an inch to the mile. The details are so minute that maps having a scale of 25 inches "show every hedge, fence, wall, building, and even every isolated tree in the country. The plans show not only the exact shape of every building, but every porch, area, doorstep, lamp post, railway, and fire plug."—San Francisco Chronicle.

The idea of utilizing the threads of the spider on a larger scale than is, or was, done by telescope makers is very old, but attempts have never been persevered in. About ten years ago a Madagascar missionary, Camboué, experimented with two kinds of spiders of that country. He seemed to be successful, but nothing further has been heard of his researches. In the professional school at Chalais-Meudon, we see from the Industrie Textile, spiders have now to spin for the benefit of the balloons which are used for scientific and military researches. The spiders are grouped in dozens before a reel which withdraws the delicate threads. One spider can give a thread from 20 yards to 40 yards in length, after which performance it is released. The threads are of a pinkish hue, and are washed to remove the sticky surface layer. Eight threads have to be combined. The resulting texture is much lighter than ordinary silk of the same bulk, and strong cords for military balloons can no doubt be obtained in this way.

In Hyg. Rdsch., E. Roth reports comparative experiments made by Bernstein regarding the value of recently proposed meat substitutes. In order to meet the requirements, they must comply with the following conditions: 1. They must be soluble in water. 2. They must have an agreeable taste. 3. They must be well assimilated when taken in large quantities. 4. The price should be moderate. These requirements are met best by nutrose, which is completely soluble in water, of indifferent taste, particularly in soups, and assimilated more completely than meat in larger quantities. Peptone is easily soluble, but has a disagreeable taste, and is, therefore, useless for most purposes. It can be taken only in small quantities. Somatose dissolves readily in water and has an agreeable taste, but can be borne only in small quantities. It is rather a stomachic than a food. Aleuronate, which is very much cheaper than all others, is insoluble in water, but has little taste, is well borne by the stomach, and is well suited as an addition to all kinds of bread and pastry.—Ph. Post.

"**It will** not be very long, I think," writes D. A. Tompkins, in The Cotton Planters' Journal, "before the manufacturing process will commence at the cotton gin. For making the coarse goods every condition at the South is favorable to the incorporation of the ginning, spinning, and weaving processes into one continuous operation. By this means the baling of cotton for market will be eliminated from the process. The opening up of cotton in the picker rooms would also be eliminated. Many items of cost connected with the production of a bale at the ginnery, its transportation to a separate cotton factory and its manufacture at the factory would be eliminated by turning the cotton at once into cloth. The problem will come to be not alone how cheaply cotton can be produced on a farm, but how cheaply cloth may be made. The production of cotton and its manufacture into cloth may become so closely allied that the farmer will occupy the same relation to spinning and weaving that he now does to ginning. Ginning is no part of the business of farming. It is manufacturing. There is no reason why the process should stop with separating the lint from the seed. The same quality of skill that can gin cotton well can also spin and weave it well. If Southern people could be brought to the same degree of confidence in their own ability to spin and weave that exists with reference to ginning cotton, then the progress of manufactures would be much greater in many portions of the South. Yet it is a question whether ginning is not the more difficult of the three operations."

The extent of the German colonial possessions and protectorates, including the recently leased territory in Kiao-chau Bay, is 2,600,000 square kilometers (1,615,577 square miles). The German empire proper contains only 540,657 square kilometers (335,931 square miles), which is not much more than one-fifth of its colonial possessions. Togo, Kameroons, and German Southwest Africa contain together 874,189 square miles. German East Africa is nearly two-thirds as large as the last named, having 584,777 square miles.

England's colonies and possessions embrace no less than 16,662,073 square miles, or more than eighty-five times as much as the motherland.

A comparative table of the extent and number of inhabitants of the European colonial possessions shows:

Country.	Extent.		Population.	
	Motherland.	Colonies.	Motherland.	Colonies.
	Sq. miles.	Sq. miles.		
Great Britain	120,979	16,662,073	39,825,000	322,000,000
France	204,092	2,506,000	38,520,000	44,290,000
German Empire	208,830	1,615,577	53,325,000	7,450,000
Portugal	36,038	800,914	5,050,000	10,215,000
Holland	12,648	783,000	4,900,000	34,210,000
Spain	197,670	405,450	17,300,000	9,800,000
Italy	110,646	242,430	31,290,000	195,000
Denmark (Faroe Islands, Iceland, and Greenland)	15,289	86,614	2,175,000	130,000

SELECTED FORMULÆ.

Preservation of Fruit Juices.—Express the juice of any fruit; filter and pour it into champagne bottles; fill them up to the bend of the necks; cork tightly and fasten the corks down with cord or wire; then put the bottles into a kettle; set them on a double sheet of coarse paper, placed on the bottom of the kettle, and pack the bottles loosely in with hay or cloths; then fill the kettle up to the necks of the bottles with cold water; place over a moderate fire and let it boil for twenty minutes, then remove the kettle from the fire, allowing the bottles to remain in the kettle until the water becomes cold; then seal the corks and pack the bottles sideways in a cool, dry cellar. Prepared in this way, they will keep in a perfect state for a very long time. Fruit pulps are preserved in precisely the same way, except that they have about an ounce of finely powdered sugar added for each bottle of pulp so put up.—Pharmaceutical Era.

De Brevans, in "Manufacture of Liquors and Preserves," gives the following formulas: Juices of Huckleberries, Barberries, Cherries, and Grapes.—Crush the fruit and pass the pulp through a horsehair sieve; crush the marc and unite and carry to the cellar. After twenty-four hours of fermentation filter and preserve. The juice of cherries is better when a mixture of black and red cherries is used.

Orange and Lemon Juice.—Remove skin and seeds, crush the pulp and press, and mix with rye straw washed and cut fine, to assist the separation of the juice. Clarify by repose, filter, and preserve.

Quince, Apple, and Pear Juice.—Peel and rasp the fruit, taking care not to touch the seeds. Press the pulp, mixed with rye straw, washed and cut fine. Clarify by repose, filter, and preserve. The quinces should be fully ripe.

Raspberry Juice.—Crush the fruit and press the marc. The liquid is allowed to repose for one or two days, after which it is filtered. One-fifth of the weight of red cherries is sometimes added to the raspberries. Another process reported to have given excellent results is this one: The clarified juice is heated to boiling in a copper vessel and then poured into a dish. Meanwhile the bottles are provided with stoppers, and are then gradually filled, a space of about two centimeters in the neck being left empty; some alcohol is then poured upon the hot liquid, and the bottle is quickly stoppered, the cork being further secured as the liquid cools. The alcohol which evaporates into the empty space is sufficient for the preservation of the juice. The juice of fresh herbs may be preserved in the same manner. This process seems to be an entirely unobjectionable one. It is generally believed that many of the fruit juices as found in the market are usually preserved by means of antiseptics and anti-ferments, such as salicylic acid, boric acid, boroglyceride, sodium sulphite, peroxide of hydrogen, formaldehyde, etc.

Floor Wax.—Yellow wax dissolved in turpentine is one of the simplest forms of floor wax, and by many accounted the most satisfactory of all. A typical formula is the following:

Yellow wax	1 part
Oil of turpentine	2½ "

Dissolve the wax in the oil by the heat of a water bath. Apply the mixture to the floor by means of a brush, and after one or two hours, rub with a woolen cloth until polished. Combinations of soap, wax, and turpentine with caustic potash are used largely. These may be put up by druggists for retailing. The following are typical formulas:

No. 1.

Yellow wax	250 parts
Water	580 "
Potash	35 "
Hard soap	74 "
Oil of turpentine	660 "

The wax is added in thin shavings to 280 parts of water contained in a suitable vessel and heat is applied until it melts; then add the turpentine. Dissolve the potash and soap in 300 parts of water, and add the solution thus formed to the hot mixture of wax, turpentine, and water; then stir until cold.

No. 2.

Potash	32 parts
Water	314 "
Yellow wax	32 "
Annatto	8 "

Dissolve the potash in the water, heat to boiling and add the wax, and finally the annatto to color.

No. 3.

Yellow wax	1 part
Kerosene	8 "

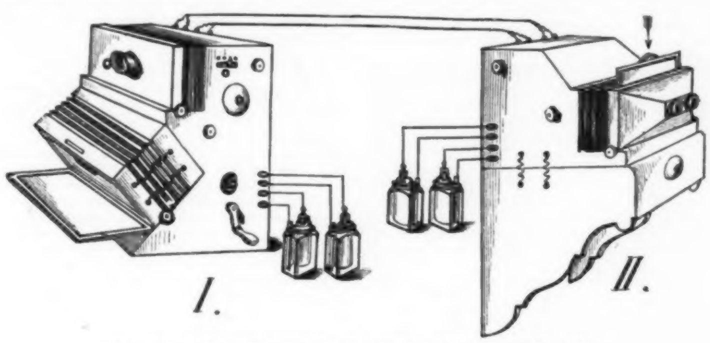
Dissolve the wax in the kerosene over a hot plate (not over open fire). The mixture while hot is spread on the floor in a thin layer. A thin layer of wax remains after the kerosene evaporates and this is rubbed lightly with a cloth until the desired polish is obtained.—American Druggist.

Printing Photographic Scenes upon Cotton Fabrics.—For a number of years a prize has been offered in Great Britain for a process whereby photographic pictures can be transferred to cotton fabrics. The problem has not been altogether solved, but E. Kopp has made a material contribution thereto, which appeared in a recent number of The English Mechanic:

Indigo salt was formerly sold in commerce as bisulphite compound, but decomposed strongly, however, in diffused daylight; even if stored in dark rooms, decomposition set in after a few months. Kopp, knowing that cotton goods prepared with indigo salt, if exposed to the light for some time before treatment with soda lye, do not show a nice blue effect, has based on this a photographic process. He prepared the cotton fabric with indigo salt, 7·5 grammes; sodium bisulphite, 40° B., 0·01 liter; soda, 1·0 gramme; water, 4·0 c. cm.; wax, $\frac{1}{10}$ liter; gum water, 0·3 liter. Dry with exclusion of light, and the fabric is prepared for the photographic printing. Expose the texture, according to the description of the cliché and the concentration of the color, from one hour to one day to the sun. The design forms in yellow, passing more or less into dark brown. Develop with caustic soda lye of 15° B. at 62° Cent. on the foulard, wash and dry.

THE "TELECTROSCOPE" AND THE PROBLEM OF ELECTRICAL VISION.

For some weeks past rumors have been rife that an apparatus has been invented in Europe by means of which events could be seen which were taking place miles away. Periodicals both at home and abroad have naturally discussed at some length the wonderful results said to have been obtained and have published extended biographies of the inventor, Jan Szczepanik. Up to the present time, however, the "telectroscope," as the apparatus has been named, has been described only in its essential structure and operation. Not until his apparatus has been exhibited at the Paris Exposition of 1900 will the inventor divulge any further details regarding the construction of several important features. Meager as the information which has been published abroad may be, enough has, however, been gleaned from foreign sources to enlighten us on the principal portions of the apparatus. If the inventor adheres to his original intention of giving out no further information, we must, perforce, content ourselves with the little that has been vouchsafed us. Therefore, until 1900 the public will not be inclined to take very seriously the claims put forward by the young inventor, as a public demonstration of the workings of the apparatus must be made before the rather vague description now published will be accepted. The subject, however, is of interest from a speculative point of view.



MODEL OF JAN SZCZEPANIK'S TELECTROSCOPE.

Even before the invention of the telephone, inventors had dreamed of converting light waves into electric impulses and of transforming these impulses again into light waves at some distant station. But the difficult problems presented in devising satisfactory apparatus have repeatedly baffled the efforts of our most learned scientists. Hertz, it is true, had proved experimentally that electrical phenomena are influenced by light in various ways, and that optical phenomena are influenced by electricity and magnetism. What is of more importance, however, Hertz discovered that the waves of electricity and of magnetism, whose existence he had proved, bore the same relation to one another as those of light. But between this wonderful discovery and the solution of the problem of electrical vision there yawned an abyss which was yet to be bridged.

Fifteen years ago rumors came from America that "telegraphic vision" was a possibility, but the reports far exaggerated the true importance of the discovery. It is now stated on good authority that the apparatus lately constructed by Jan Szczepanik conducts light undulations by means of wires, transforms them into electricity at any desired place, and makes them visible to a human eye.

This wonderful feat has been accomplished with the assistance of an element but little known outside of the chemical laboratory, and called by physicists "selenium."

Selenium was discovered in 1817 by Berzelius, and, like gold and other rare metals, is found rarely in large masses as a pure ore. It is, however, widely distributed in small quantities as a constituent of numerous substances. In many industrial processes it is obtained as a by-product, and is formed, for example, in the lead retorts of sulphuric acid works as selenic acid, from which, by chemical means, the pure selenium is obtained. In its chemical and physical properties, selenium bears a striking similarity to sulphur, and, like the latter, occurs in various allotropic forms, i. e., although the original substance may be the same, the molecular arrangement is such as to impart different properties to the element.

One of these allotropic modifications, which, on account of its bluish-gray sheen, has received the name of "metallic selenium," possesses the remarkable property of conducting electricity with a facility that varies with the intensity of the light that falls upon the material. Upon this remarkable property are based all attempts at devising apparatus for electrical vision,—attempts which were first begun by Bakewell in 1847.

The discovery of Szczepanik, in brief, consists in allowing the rays emanating from an object to fall upon a "cell" of selenium. Electric impulses will be produced in the selenium whose intensity depends upon the brightness of the rays falling upon the "cell." These impulses, being conducted to a distant receiving-station, are there transformed again into light. The rays which fall upon the selenium are first separated into points of light by oscillating mirrors in the transmitting station. Similar mirrors in the receiving station vibrate synchronously with the mirrors of the transmitting station and reproduce the image of the object.

Of the accompanying illustrations, Fig. 1 represents the transmitting and receiving stations; Fig. 2 is one of the oscillating mirrors; Fig. 3 the electro-magnets controlling the oscillations of the mirrors; Figs. 4 and 5 are plan and sectional views of the selenium cell; Figs. 6 to 9 represent various methods of analyzing the image to be transmitted.

Each of the four mirrors, *a*, has a surface of great purity and reflecting power. With the exception of a single fine line, these mirrors are covered with an opaque substance. Each mirror is fastened to an iron plate, *b*, constituting the armature of an electro-magnet, *E*, and turning about an axis, *c*. By the attraction of the armature, *b*, the mirrors, *a*, are turned on their axes, and, consequently, new lines of the object are constantly reflected. If the second vertical mirror, *a*, controlled by the electro-magnet, E^1, be mounted upon its armature, b^1, so that the reflecting lines of the two mirrors shall be perpendicular to each other, then at a certain position but a single point of the reflected line of the first mirror will appear on the second mirror. Only the beam corresponding to this point is reflected by the second mirror. If the two mirrors turn upon their axes, then, after double reflection, rays of light from various points of the object will fall in quick succession in an opening, *o*, of the screen, *w*, of the transmitting apparatus, *A*. In order to illustrate how the various points of light are produced, let us suppose that the first mirror, *a*, of the transmitting apparatus oscillates in the direction of the abscissa, *x*, in Figs. 6 to 9, and that the vertical mirror, *a*, of the transmitting apparatus swings in the direction of the ordinate, *y*. The resultant of these two directions must be the line, *K*.

On a plate behind the opening, *o*, in the screen, *w*, are mounted several selenium "cells," *s*. One cell would not respond with sufficient rapidity to the rays of light. A clockwork mechanism keeps the plate in constant rotation, offering new cells to the reflected pencils of light. These "cells" are connected as shown to wires, *L*, of the battery, *B*, so that the electrical impulses produced may be conducted to an electro-magnet, E^2, in the receiving apparatus, A^1. Current is shunted from the circuit, *L*, to illuminate an incandescent lamp, *l*, in the receiving apparatus. To the armature of the electro-magnet, E^2, of the receiver, a prism, *p*, is fastened and so situated that the rays which are refracted by it shall pass through an opening, o^1, in the screen, *w*, of the receiving apparatus, A^1. Lined mirrors similar to those of the transmitting apparatus are attached to the armatures of the electro-magnets, *E* and E^1, and turn upon the axes, *c*, of their respective magnets.

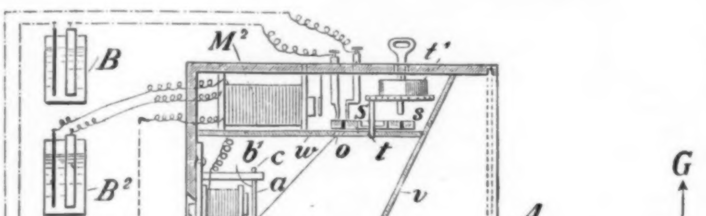


FIG. 1.

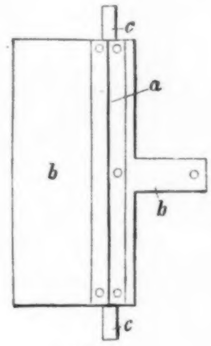


FIG. 2.

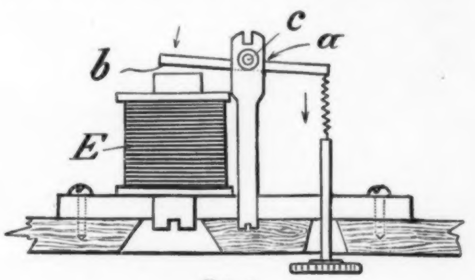
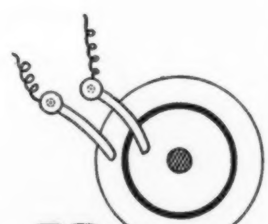


FIG. 3.

FIG. 4.



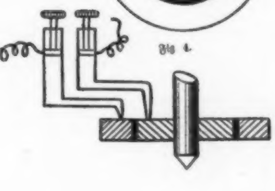


FIG. 5.

FIG. 6.

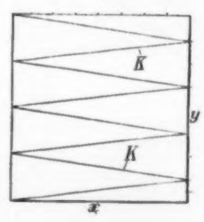
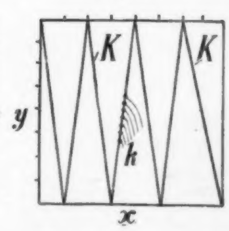


FIG. 7.



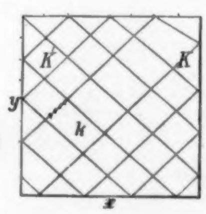


FIG. 8.

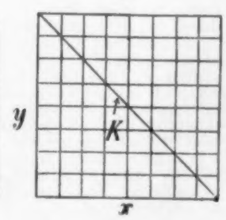


FIG. 9.

In order that the mirrors, *a*, attached to the armatures, *b*, of the electro-magnets, *E*, of both the receiving and the transmitting apparatus, shall swing synchronously, they are connected to a battery, B^1, and to an

interrupter, M^1. In order that the vertical mirrors, a, secured to the armatures, b^1, of the electro-magnets, E^1, of both the transmitting and the receiving stations shall also perform their oscillations in equal times, they too are connected with an interrupter, M^2, in the manner shown in Fig. 1. The interrupter, M^2, is connected to the battery, B^2, and to the electro-magnets, E^1, as indicated in Fig. 1.

A ray of light coming from the image, G, of an object, the image being produced by a lens, falls upon the rapidly oscillating lined mirror, a, and is then reflected to the similarly lined vertical mirror, a, attached to the armature, b^1, of the electro-magnet, E^1. As before mentioned, the reflecting lines of these two mirrors are perpendicular to each other; consequently, only a beam corresponding to the single point of light from this particular ray will pass through the opening, o, in the screen, w. The selenium, s, will be electrically excited in consequence of the ray produced by the reflected point of light falling upon it. A current will be generated, whose intensity depends upon the brightness of the ray produced by the point of light which has just fallen upon the selenium. The electrical current thus excited is conducted through the wires, L, to the electro-magnet, E^2, of the receiving apparatus. Since the selenium, s, is sensitive not only to light but also to color, it follows that the current produced in the "cells" by a certain color causes the armature of the electro-magnet, E^2, to be attracted with a force that varies as the intensity of the current excited in the selenium. Consequently, the prism, p, attached to the armature of the electro-magnet, E^2, will move to a greater or less distance, depending upon the brightness and color of the ray falling upon the selenium "cell," s. The prism, p, is therefore so mounted, that of the light coming from the incandescent lamp, l, and analyzed by the prism, p, only that ray can pass through the opening, o^1, which coincides in color with the ray at that moment illuminating the selenium "cell," s. The ray which then emerges from the opening, o^1, in the screen, w, falls upon the mirrors, a, and together with the rays immediately following it produces a perfect image of the original image, G, at G^1. Exactly how this perfect image is produced requires a few words of explanation.

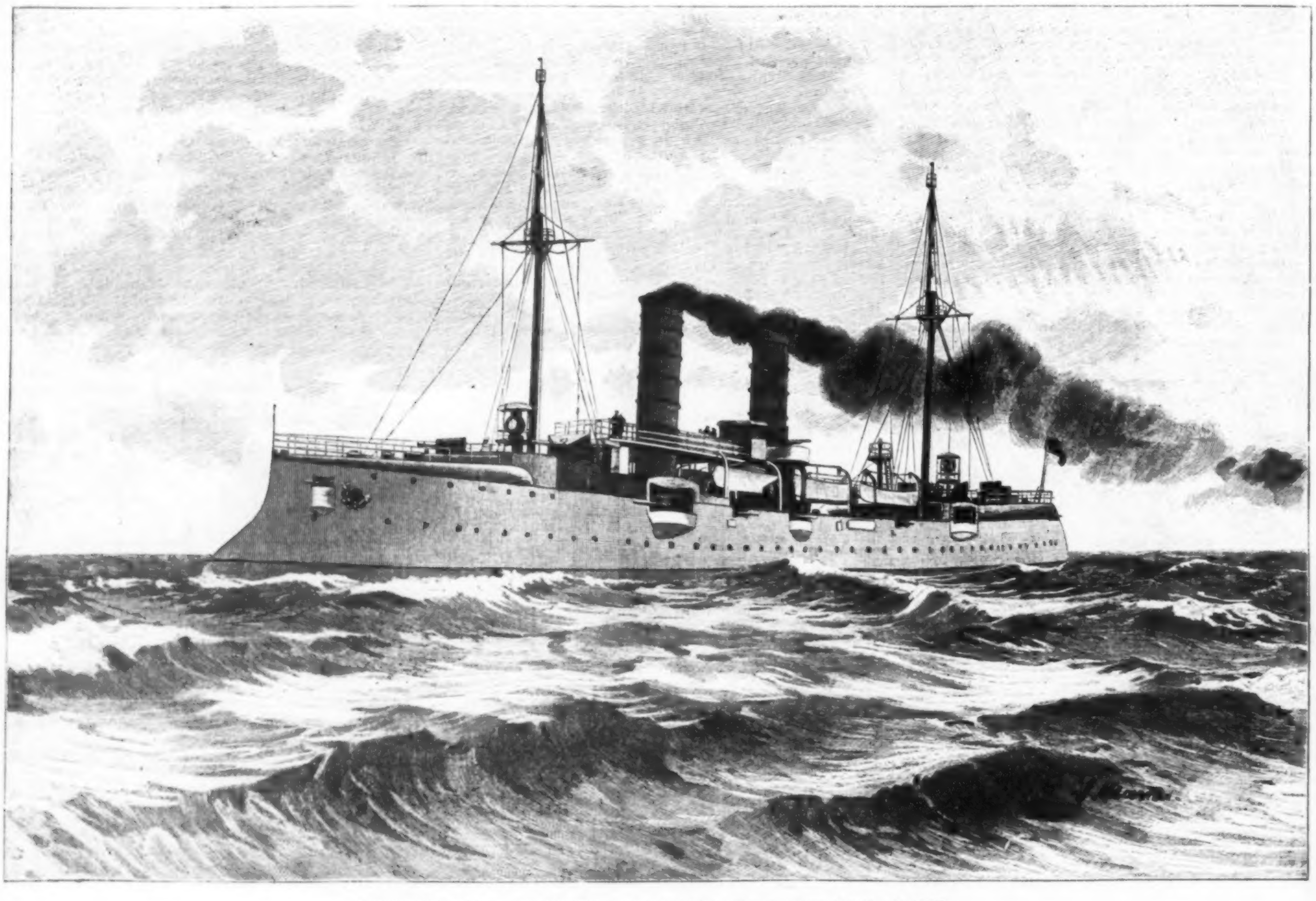
The retina of the human eye possesses the peculiarity of being sensitive to a light impression, even after the source of light has been extinguished, and for this reason it is, that the unusually rapid vibrations of the mirrors are perceived by our consciousness simultaneously and call forth an image, the exact reproduction of that transmitted from the first station. We have all seen how a spark on the end of a match when rapidly swung in a circle produces the impression of a ring of light. In an exactly similar manner, the rapidly succeeding points of light falling from the object upon the mirrors apparently produce an image of the original object. The question then naturally arises: Is it possible to oscillate the mirrors with sufficient rapidity to produce a series of points which, following one another with such rapidity, will cause a picture of the object to be seen at G^1? The sciences of mechanics and electricity as practiced nowadays, have made it possible to cause the mirrors to oscillate with such rapidity and precision, that several thousand vibrations can be performed in a single second.

Since the mirrors swing on axes perpendicular to each other, the number of points projected on the selenium in the transmitter will be equal to the product of the number of oscillations performed by the two mirrors. If, for example, each mirror swings on its axis only 100 times in a second, then 10,000 points of light will in a like period fall upon the selenium, and be transmitted. As a matter of fact, the image points may number hundreds of thousands or even millions. So rapid are the oscillations of the mirrors that the tenth part of a second is sufficient to analyze the image of an object in the transmitter and to render it visible at the receiving station. It is therefore possible to transmit a continuous action, such as a theater performance, over the wires of the telectroscope, since the pictures received follow one another so rapidly as to produce the impression of a moving image, just as the numerous separate pictures of a chronophotographic apparatus reproduce past actions.

Of the future possibilities of the telectroscope, but little can be said as yet. That it will have a great commercial value cannot be doubted for a moment. The transmission of long newspaper messages would, for example, be considerably facilitated. It would only be necessary for a correspondent to write his dispatch on ordinary paper and to hold it before the transmitting apparatus. A silver bromide plate properly placed in the receiving apparatus will photograph the message, and thus save the vast amount of time ordinarily consumed by telegraphing.

For a portion of our information we are indebted to Die Illustrirte Zeitung.

FOURTH-CLASS CRUISER "G" OF THE GERMAN NAVY.



FOURTH-CLASS CRUISER "G" FOR THE GERMAN NAVY.

A VESSEL is now being constructed at Krupp's Germania Dock, at Kiel, which is worthy of note as being the first of the cruisers assigned to foreign stations that has been built without any provision for sails, and therefore of a type heretofore unknown in the German navy. Aside from the little gunboats, which are also adapted to navigate the rivers for some distance into the interior of the different countries, the cruisers heretofore used by Germany at her foreign stations were the smallest in her navy. They depended to a certain extent on their sails, and were, consequently, far behind the times in regard to speed as well as to armament, so it was decided that an improved and enlarged type of vessel must be provided at once for this branch of the service. As sails were to be abolished on the new vessel, it became necessary to provide stronger engines, greater coal-carrying capacity and increased dimensions. The displacement of the new vessel will be 2,600 tons, while that of the old ones is only 1,600; the length of the cruisers will now be 328 feet (formerly it was 249 feet 4 inches); the beam 38 feet 8 inches (32 feet 9 inches), and the draught 15 feet 8 inches (formerly 14 feet 5 inches). The horse power has been more than doubled, having been heretofore only 2,900 and being now 6,000, so that the new boat will have a speed of about 20 miles an hour, while the speed of the old ones was only 16 miles. On account of the increased coal-carrying capacity, the radius of action is considerably greater than formerly.

The steel hull of the new vessels will be provided with a covering of wooden planks, and over this there will be a coating of Muntz's metal to prevent fouling. Cork will be used on the inside of the hull.

For the armament only rapid-loading guns will be used, including fourteen revolving cannon, eight machine guns, and ten rapid-fire guns of 4-inch caliber. The old vessels have only fourteen guns, half of them being revolving cannon and the other half rapid-fire guns. The new cruiser will have three torpedo tubes; the old ones have only two. The use of armor for the deck and the conning tower marks a decided improvement in the new cruiser over the old ones. As no sails will be employed, only signaling masts will be provided. In the construction of the cabins the use of wood has been avoided as much as possible. The crew will consist of 190 men, against 160 men for the old cruisers. The entire cost of the new cruiser, which will be ready for service in 1899, will be about $952,000.—Illustrirte Zeitung.

"THE ENGINEER'S" REPORT ON THE DESTRUCTION OF THE SPANISH FLEET.

THE end has come not only to Admiral Cervera's operations, but to the actual existence of his ships. Like Francis the First at Pavia, he may say, "All has been lost, all except honor." This sentence, indeed, is, perhaps, more true of the Spanish fleet than of the French army, of which it was spoken, for in the case of this fleet it includes not only the actual loss of the ships, but the loss of conditions on which efficiency depends, and the loss of judgment, almost of common sense. This is not being wise after the event. In our number of June 3 we expressed our wonder at the failure of Spain to use her one formidable element, her body of swift powerful cruisers, to some purpose. First, we wondered at their separation. This rendered them almost useless for fighting in the West Indies. We pointed out, however, that there was a time when Cervera's fleet or division was so placed that, had he gone to the Philippines, he had some days' clear start of anything that could come from America, and that he had abundant strength either to drive away or to defeat Admiral Dewey. We pointed out that, instead of this, he had shut himself inside a harbor, round which naturally gathered a sufficient force of American warships to crush him if he should come out. We suggested that difficulty in procuring coal may have crippled his action, but one feature stood clear throughout on which depended all that he could do—namely, the peculiar combination of speed with a considerable measure of strength which belonged to the Spanish cruisers. It was even possible that the fleet, after it was shut up, might escape, for it might slip out and run the gauntlet of the American fleet's fire. Writing to-day, we confess that we can hardly account for the gallant attempt made to break out having had absolutely no promise of success from the commencement. It is difficult to believe that the American ships could have remained under full steam habitually; yet it is clear that they were so when the Spanish fleet came out, for we read that "in a few seconds the American fleet was in motion." Had their fires been banked, it would have been more like three-quarters of an hour before full steam could have been got, and the Spanish ships should by that time have secured a considerable start.

Let us, however, look at what happened. Inside the harbor of Santiago de Cuba lay Admiral Cervera with four armored cruisers, the "Cristobal Colon," the "Oquendo," the "Vizcaya," and the "Infanta Maria Teresa." Outside lay Admiral Sampson with the main

strength of the entire United States navy, including the battleships "Iowa," "Indiana," "Massachusetts," "Oregon," and "Texas," and the powerful armored cruisers "Brooklyn" and "New York," besides other vessels of less importance. Admiral Cervera's dash to get out, then, meant the attempt to run four cruisers through the assembled battleships of the United States navy. One chance, and only one he had. The United States ships, not being able to keep up full steam for successive weeks, ought to be caught with banked fires, and thus if he could run the gauntlet of their batteries he might easily obtain, as we have said, some miles start of them. His speed in theory exceeded that of the great battleships by three knots or more. The "Brooklyn" and "New York," it is true, had one knot higher speed than the Spanish ships; but could they alone, or with support only from some possible United States unarmored cruiser, overhaul and defeat the four Spanish armored cruisers? Only, we think, if the latter had been heavily injured in passing through the line of battleships. So far as we understand it, this was the position of matters when Admiral Cervera made his gallant but ill-fated dash out of the harbor. At the moment chosen one circumstance favored the attempt. Admiral Sampson with one of the two swift ships, the "New York," was away from the mouth of the harbor. Everything, then, depended on the state of readiness in which the terrible battleships were found. A bold rush, if it could be made absolutely without warning, might succeed. No vessel, in theory, could be better suited to attempt it than these unusually swift and powerful Spanish cruisers. At the moment that Admiral Cervera led the way in the "Cristobal Colon," supported by the guns of Fort Morro, especially if he believed that he was taking the Americans by surprise, he may well have had hope of success; but such hope must have been almost extinguished in a few minutes. So instantly did the United States battleships fire and move that we must conclude that if, as they say, they were taken by surprise, they were fortunate enough to have steam up for some other purpose. Beating to quarters and getting up steam could not be accomplished in "a few seconds." Surely such a condition of readiness as these words argue must have been apparent to the Spanish in Santiago had they kept a tolerably sharp lookout. In a few seconds, however, we are told the "Indiana" closed on the "Cristobal Colon;" nevertheless, the latter gallantly passed her, rounding and delivering a broadside, only to come under the fire of the "Iowa" and "Texas," and, lastly, the "Oregon" and "Massachusetts," while the "Indiana" first, and then also the "Brooklyn" and "Texas," attacked the "Oquendo," which immediately followed the "Cristobal Colon." The "Vizcaya" next emerged and followed the "Cristobal Colon" and "Oquendo" westward. The "Iowa" now steamed with the "Oquendo," and the "Indiana" with the "Vizcaya." Not a word is said as to the "Infanta Maria Teresa" coming out at all in any of the accounts, except the bare fact that she with the others had been forced on shore and burnt, as stated in General Shafter's and Admiral Sampson's telegrams.

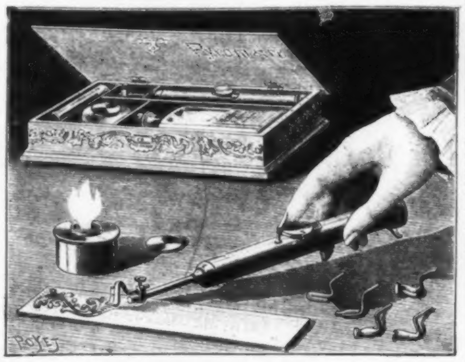
The thick armor of the Spanish cruisers stood them in good stead, for it may be seen that it enabled them to do all that ought to have been necessary to escape, had a real surprise been effected. The chances of escape, however, were greatly decreased now that the United States battleships were actually running with them. True, had all been in good order, the Spanish ships should leave them behind at the rate of three miles an hour, but even so, it was to be feared that in this process the American fire would cripple their speed. Probably, however, the Spanish speed, like everything else Spanish, had to be terribly discounted. We have, indeed, recently heard on good authority that some of the bottoms of their ships were in a state that baffles description, so that it is probable that the American battleships were actually swifter than their prey, for this was what it had come to. We have noticed the deficiency of quick-fire guns in American battleships, and we think that the fact that the Spanish cruisers passed them with so little damage points the moral to this deficiency; but under the conditions we have before us, the destruction of the Spanish cruisers could only be a matter of time; the process might be faster or slower, but could hardly fail to be sure. The "Cristobal Colon" was the strongest and most modern Spanish ship, consequently, although she led the way into the zone of danger, she made by far the best struggle to escape. As the vessels steamed along the coast to the west, the "Oquendo" turned despairingly into a small bay five miles to the west of Santiago, and the "Vizcaya" followed her. The "Indiana" and "Iowa" closed in upon them and set the "Vizcaya" on fire, and then appeared to have pursued the "Cristobal Colon," in which Admiral Cervera still raced with the "Brooklyn" and "Oregon"—a race which ended in 3,000 yards by the "Cristobal Colon" running on to the rocks, being then on fire.

The capture of half the Spanish war-vessels is to Spain what Sedan and Metz were to France in the Franco-German war. In each case a persistent infatuated rush was made into a trap, which was obvious to lookers-on—a rush which was without benefit to Metz, and equally without benefit to Santiago. Here we have not only superior strength, but supplies, foresight, efficiency, information and good gunnery, all on the side of the American navy. The Americans must, we think, have had at least some inkling of what was likely to come, or if not, were under steam for some other reason, and must have shown evidences of it. To this the Spanish seem to have been blind. The Americans had coal, of which there is reason to question if the Spanish were not short. The American ships seem to have maintained actually higher speed than the Spanish. Their fire was sufficiently well aimed to tell, while the whole of the Spanish fire seems to have been wasted. Even the Chinese at Yalu produced much greater effect with their unsuitable solid steel shot than the Spanish guns on this occasion. This suggests a ghastly possibility. Did the Spanish fire blank, owing to the absence of projectiles? Some shot they doubtless had; even the splashes proved this, but they may have been very few. One killed and two wounded is the reported American loss. Admiral Cervera and those under him have fought like gallant Spanish gentlemen, but we cannot say that the Spanish fleet has acted like a fleet of the end of the nineteenth century.—Engineer.

A NEW PYROGRAPH.

THERE are already a large number of pyrographs, but all of them present a certain number of inconveniences, among which is the odor of benzine and smoke which they constantly emit. We illustrate herewith, from La Nature, a new form of the apparatus in which ether is employed, and in the use of which no danger is to be feared if certain precautions are observed.

The apparatus consists of a tube six inches in length and about half an inch in diameter provided at its lower extremity with a screw cap and a small support. At the opposite extremity there is placed a bent rod



A NEW PYROGRAPH.

to which the drawing point is fixed by means of a screw.

In the center of the apparatus there is a valve regulatable from the exterior by means of a large screw with a milled head. This screw is provided with a notch which limits its travel through the intermedium of a click. Upon the top of the screw are the two letters, A and Z. In order to open the valve, the regulating screw is turned from left to right, so as to bring the letter A near the stopping point. In order to close it, the screw is turned from right to left until the letter Z touches the stopping point. The apparatus should constantly rest upon the small support at the extremity, so as to make the regulating screw point upward.

For the formation of the combustible gas and for heating the rod, sulphuric ether, that may be procured at any drug store, is employed. This liquid, which is very inflammable, demands the same precautions as benzine. It should therefore not be poured out in the vicinity of an exposed flame. In a closed receptacle, however, no danger is to be feared from it. In order to fill the apparatus, the cap is unscrewed and the contents of the graduate (which should be filled only up to the proper mark) are poured in. The odor of the ether, which is not disagreeable, although quite intense, and which puts itself in evidence on this occasion, disappears completely during the work. Moreover, the odor is in nowise injurious to the health.

At this moment, the regulating screw must be turned to the left in order that the letter Z shall come against the stop. In order to expedite the formation of gas, the apparatus is held for a few seconds over a spirit lamp with the regulating valve turned upward. At the end of a few seconds the regulating screw is turned, and the jet of gas coming from the extremity of the drawing point is lighted. After this the flame is regulated, and, since the rod is adjustable in its sheath, it may be so turned that it shall be struck at right angles by the flame, which varies in size according to the position of the regulating screw, and consequently heats the rod to a greater or less degree. After such preparations, which consume a few minutes, it is possible to work for two consecutive hours at an expense of a fraction of a cent for ether. The vapors disengage themselves constantly and feed the small flame, which during the work is scarcely observable. It is only during very violent movements and when the apparatus is shaken that the flame dances momentarily. The heat, which is always uniform, permits of a sure and sharp execution of the design upon all materials, even upon leather.

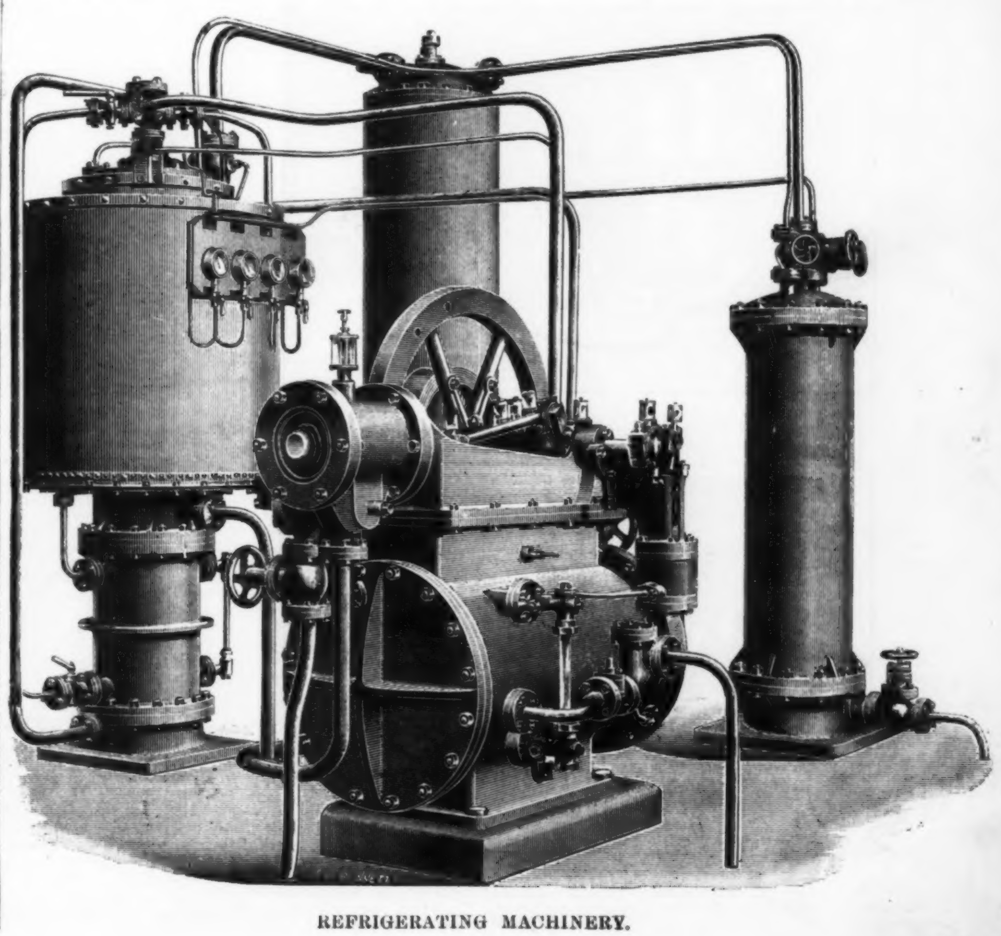
With this pyrograph, it is possible to draw the finest and most delicate lines, and there is no danger of burning holes in the material. Since the left hand is free, the object to be ornamented can be turned and directed at will according to the requirements of the work. If it is desired to extinguish the flame after the drawing is finished, the valve is closed by turning the regulating screw, and the apparatus is placed upon its support in order that it may preserve the same position that it had while the work was in progress.

The box of the pyrograph contains a spirit lamp, a graduate, and five different drawing points that are easily interchangeable and permit of operating on wide surfaces and forming regular stars, double lines, dots, and other figures.

AMMONIA ABSORPTION REFRIGERATING MACHINE.

THOUGH, as pointed out by Prof. Ewing in his Cantor lectures on Mechanical Refrigeration, an absorption ice-making machine has necessarily a lower theoretical efficiency than a good compression machine, the former can, nevertheless, do very excellent work, and is especially useful in cases in which it is necessary to work at varying rates of refrigeration. Owing to the elasticity of the system in this regard, machines of the absorption class were adopted in the plant for the house-to-house distribution of cold erected some years since at St. Louis, U. S. A. A fine machine of this type constructed by the Société Anonyme des Ateliers de Construction de J. J. Gilain, at Tirlemont, Belgium, was exhibited at the recent Brussels Exhibition, and was awarded a silver medal by the jurors. This machine is illustrated herewith, and is constructed on the "Vallicély system," the peculiarity of which is the use of a pump worked by the ammonia vapors themselves, instead of from an independent source of power, for pumping back the ammoniacal liquors from the regenerator into the boiler.

The general working of machines of this class is well known, but it may be useful to shortly recapitulate here the cycle of operations through which the working fluid passes. A boiler containing strong ammoniacal liquors is heated, and the ammonia driven off. The gas on leaving the boiler passes through a series of coils, surrounded by cooling water, and on its temperature being thus reduced it condenses to a liquid form, the latent heat liberated in the process being carried away by the cooling water. The liquefied gas is then



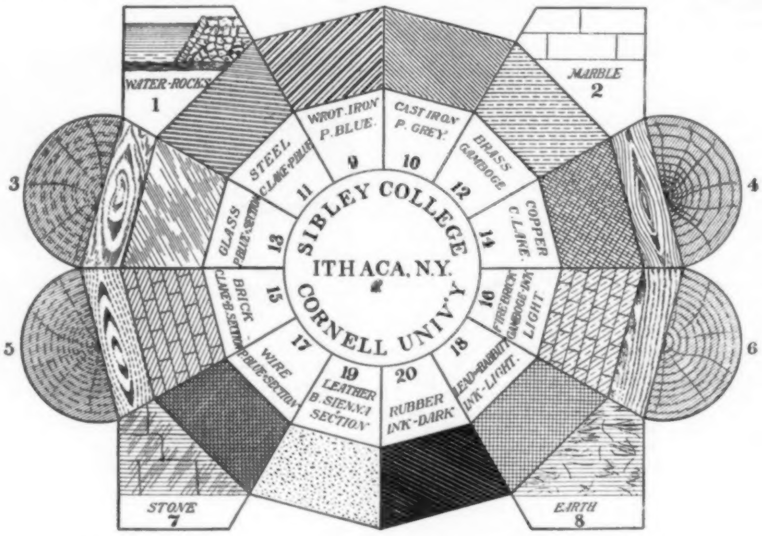
REFRIGERATING MACHINERY.

passed through an adjustable cock into the refrigerator, when it, the pressure being reduced, evaporates again, the latent heat taken up being obtained from the brine surrounding the refrigerator coils. This brine is thus greatly reduced in temperature, and can be used for ice making and similar purposes. On leaving the refrigerator the gas enters the regenerator, where it is reabsorbed by weak ammoniacal liquor drawn from the boiler. There being an evolution of heat accompanying this absorption, it is necessary to keep down the temperature by means of a liberal supply of cooling water. The water from the regenerator having been thus recharged with ammonia, is pumped back into the boiler, where the same cycle of operations is recommenced. Usually this pump is independently driven by some outside source of power; but in the Vallieély machines it is driven by the ammoniacal vapors themselves on their passage from the refrigerator to the regenerator.

In the machine shown in our illustration the boiler is steam heated, and is worked at a pressure of from 113 pounds to 128 pounds per square inch; while the pressure on the refrigerator side, from which the pump is worked, is but 7·1 pounds per square inch, so that there is no difficulty in obtaining tight joints and packing on the driving cylinder. The steam required for heating the boiler is stated by the makers to be 1 pound per 2½ pounds of ice produced from water originally at 53·6° F., while from water at 68° F. 1 pound of steam will produce 2 pounds of ice. It is claimed that these results can be obtained in everyday operation of the plant. As already stated, the special feature of the machine illustrated is the use of a feed pump driven by the ammonia vapor itself. As one result of this, it is claimed that the plant requires very much less attention, as the feeding of the boiler from the regenerator is automatically adjusted to the amount of refrigeration effected. In order to avoid freezing of lubricants, etc., in the driving cylinder, the gas entering the same from the refrigerator is first passed through a reheater kept warm by circulating water coming from the cooling coils in which the ammonia was originally liquefied.—Engineering.

"ANGLIAN" PORTABLE ELECTRIC MOTORS AND DRILL PRESS, WITH FLEXIBLE SHAFT.

IN the illustrations we show the "Anglian" portable electric motors and drill press with flexible shaft, the sole agents for which are Messrs. Selig, Sonnenthal & Company, engineers, 85 Queen Victoria Street, and Lambeth Hill, London, E. C. This combination was constructed in the first instance for drilling in ships' decks; but has since been much in demand for drilling and tapping in all cases where hand labor has been hitherto employed; and wherever it is desirable, on account of weight or position of the work, to take the tool to the latter, instead of taking the work to the tool, it is claimed that a great saving is effected. The motor is wholly ironclad and therefore proof against water and dust, and will stand such rough usage as is usually received by this class of machine. The armature shaft runs at 1350 revolutions per minute, and change wheels are provided whereby the speed of the power shaft is reduced to the ratio of 6, 3·6 and 2·5 to 1, so as to suit the size of hole which is being drilled or tapped. The lubrication throughout is automatic, so that the machine will run for weeks without any attention in this respect. On the iron case are fixed a starting switch and an electric cable socket with 20 yards of flexible cable. The starting winding of the motor is suitable for circuits of 100 to 110 volts; but this may be altered at a slight extra cost. Fig. 1 shows the application of the apparatus for shipbuilding and repairing; Fig. 2, for water tube boiler makers, showing flexible shaft combined with Yarrow's tube expander at work on a water tube boiler; Fig. 3, for engine or locomotive makers; and Fig. 4, for bridge building. The application of these electric drill motors will also be found very suitable for track drilling, wherever it is desirable to perform the work outside the shop, on the track or in the yard, for drilling rails or girders. We are indebted to The Steamship for the cuts and particulars.



STANDARD CONVENTIONAL SECTIONS FOR DRAWINGS.

THE NEW SYSTEM OF CONVENTIONAL SECTIONING.

OUR engraving illustrates a set of conventional sections prepared originally for use in the Sibley College of Mechanical Engineering, of Cornell University. They were prepared by Mr. J. S. Read, in charge of mechanical drawing and locomotive design in this institution. Our engraving is made from his new book entitled, "A Course in Mechanical Drawing," which has just been published by John Wiley & Sons. It is, of course, not intended that the sections should be used on either rough or hurried drawings, but they will be useful in all cases where well finished and artistic drawings are required. Fig. 1 shows a conventional method of drawing sectional rock, wall, and water. When no color is to be used, as in tracings for blue print making, the rocks are shaded with India ink and no color is used. A No. 175 Gillott pen is recommended. For colored drawing the groundwork is made of gamboge or burnt umber, and the water is represented by a wash of Prussian blue. No. 2 shows a conventional method of representing marble. The whole section is thoroughly wet, and then each stone is streaked with Payne's gray. Building stone is shown in the opposite corner and is made with a light wash of Payne's gray, the shading being added with ruling and writing pens. Fig. 8 shows the method of representing earth. The body is made by washing with India ink and neutral tint with India ink in irregular penned lines. Our engraving shows four kinds of timber. No. 3 is chestnut and is made by a ground wash of gamboge with a little crimson lake and burnt umber. The colors for graining in the sections of the chamber should be crimson and consist of burnt umber, Payne's gray and crimson lake in equal but sufficient quantity to make a contrast with the ground color. Fig. 5 shows black walnut, and consists of a ground of Payne's gray, burnt umber, and crimson lake in equal quantity, using the same mixture with the addition of some burnt umber for the graining.

Fig. 6 shows hard pine. It is colored with a light wash of crimson lake, burnt umber, and gamboge and in equal parts with a graining mixture of crimson lake and burnt umber. Woods in general are shown in Fig. 4, which should be colored with a light wash of burnt Sienna and grained with a writing pen and a dark mixture of burnt sienna and India ink. The other sections are solid wash colors and do not call for special comment. Various other conventional sections are clearly shown in the engraving.

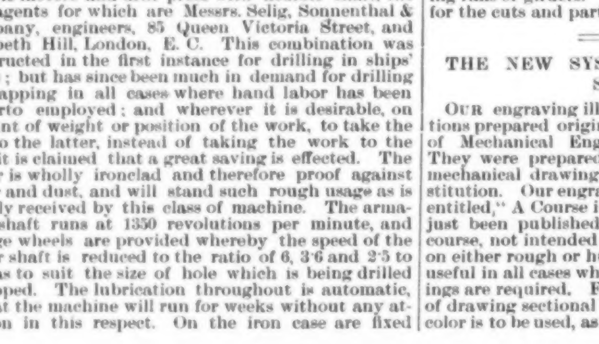


FIG. 1

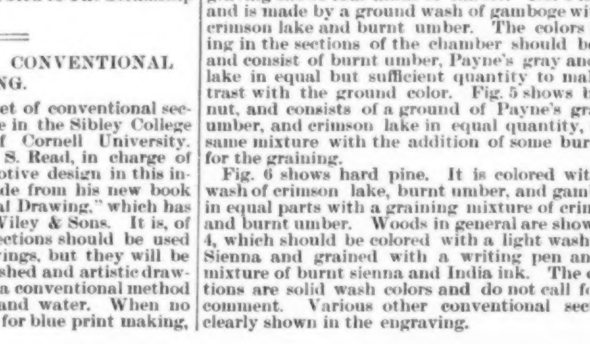


FIG. 2.

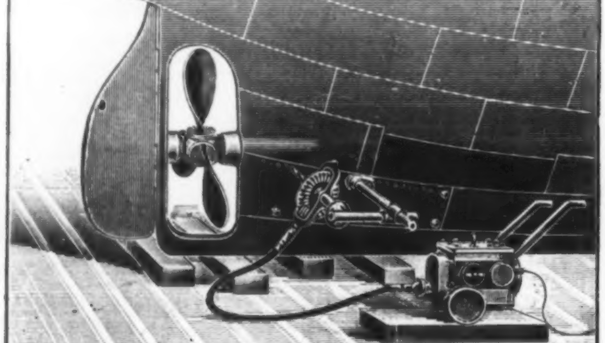


FIG. 3.

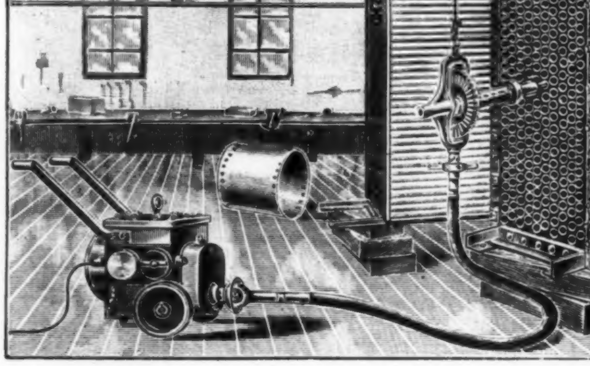


FIG. 4.

COMBINED PORTABLE AND STATIONARY ELECTRIC MOTORS.

THE WERNER MOTOCYCLE.

AUTOMOBILISM is daily assuming a greater development, and the manufacturers of gasoline carriages are scarcely able to supply their orders. On the day upon which prices become lower we shall see the number of scorchers increase in large proportions, since, at present, the relatively large sum that has to be expended for the purchase of a carriage is in most cases the only thing that proves a drawback to the amateur. When the De Dion-Bouton tricycle made its appearance, it immediately met with extraordinary success. The fact was overlooked that there was anything selfish in a vehicle to seat but a single person, and the acquisition was made of it. There were doubtless households in which the reproaches must have been something terrible, and so a back seat was soon added to the machine. After the tricycle we have the bicycle, the cost of which is a third less. The Messrs. Werner Brothers have devised a type of motocycle which recalls in no respect the first experiments made in this direction. They divest the ordinary machine of scarcely any of its elegance and add but little weight thereto in order to render it automobile. Their gasoline motor, P, which weighs but 22 pounds, is fixed against the handle bar and permits of disposing of 435 foot pounds, say a little over two-third horse power. The fly wheel, V, makes 1,200 revolutions per minute and is connected through a belt with a grooved pulley mounted upon the spokes of the front wheel, which thus becomes the driving and steering one. The carbureter, C, and the gasoline reservoir, R, are placed at the upper part of the frame. Lighting by an electric tube has been preferred to electric lighting (which necessitates an accumulator that cannot be recharged everywhere), and the reservoir, A, which contains the gasoline for the lamp, is placed upon the wheel like a mud guard.

Near the grip of the handle bar there is a handle, M, for starting or stopping the motor. The crank bracket is so modified that the feet can rest immovable upon the pedals as soon as the machine has run the few yards necessary for setting the motor in operation. The machine as a whole weighs scarcely 65 pounds. Its manufacturer assures us that it is capable of making 20 miles an hour. We have not verified this statement, although we have seen the machine in operation. In our opinion, however, such a speed is not necessary. We may even say that, personally, we should prefer the tricycle (upon which one is more stable and more of a master of himself), although it is heavier, it is true, and is less easily stored and cannot pass over all roads. There are pros and cons, but if, as the Messrs. Werner seem disposed to allow, the motor can be had separately, each person will be able to choose at his convenience, according to his taste and the object that he has in view. As a general thing, cyclists have a tendency to attain much too great a speed, and hence the deplorable accidents that injure the cause that they desire to sustain. Our roads are not made for vehicles that run at the speed of an express train, and are not, like railroads, free from all obstacles, but far from it, and it would be well to use them with a little more moderation.—La Nature.

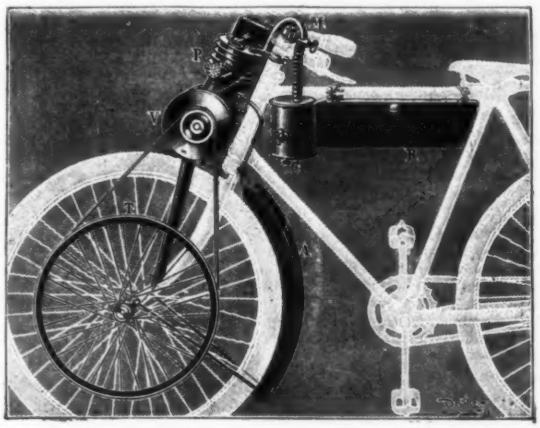


FIG. 1.—GENERAL VIEW OF THE WERNER MOTOCYCLE.

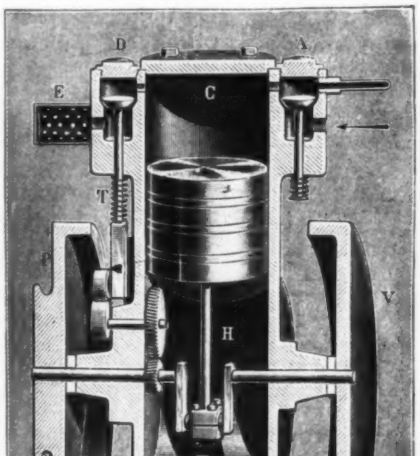


FIG. 2.—DETAILS OF THE MOTOR.

PROCURING TORTOISE SHELL.

THERE are many articles of daily and hourly use, constantly passing before our eyes and through our hands, about the production of which we know comparatively little or nothing. An interesting example of this is tortoise shell, from which combs and hairpins are made, besides a multitude of trinkets for the dressing table, the desk, and the pocket. Fierce crusades have been instituted in recent years against the slaughter of birds for the procurement of their plumage for hat trimmings, and yet I venture to say, says a correspondent of The New York Evening Post, that the process of procuring tortoise shell is a cruelty to animal life which far exceeds that to which birds are subjected.

In the eighties I happened to be down in Bluefields, on that awful Mosquito Coast, and at the invitation of one Manuel Latona, who was the owner and captain of a small schooner, went with him to the cay El Roncador, for tortoise shell. This cay gets its name (which in English would be The Snorer) from the exceedingly angry surf, which can be heard for a long distance breaking over the reefs. This is the cay on which, a couple of years back, the historic old ship "Kearsarge" was wrecked and battered to pieces. El Roncador is nothing more nor less than a typical coral island, such as is found throughout the southern seas, three-quarters of a mile long, perhaps, and not more than a quarter of a mile across its widest part. Surrounding the island is a reef, inside of which the water is smooth and rather shallow; and at the bottom of this shallow water there grows a peculiar kind of sea grass, which is a dainty food for the turtle tribes. There is also found on the top of the water inside the reef a sort of small blubber fish, called in Spanish dedales, or thimble fish, which is, perhaps, the greatest delicacy of the entire turtle menu.

The turtle whose shell is valued in commerce is a small species known as the hawk's bill. There are other varieties which come to El Roncador to spawn, but they are not molested. During the night the turtles crawl up on the shore to lay their eggs, each female depositing on an average about seventy. To do this they dig holes in the sand about two feet deep, and, after laying the eggs, cover them over so deftly that it is almost impossible for a novice to find them. These eggs are really delicious when roasted, but the turtle fishers are careful not to destroy those they do not take for food, so as to promote as much as possible the increase of this valuable sea reptile. At night the fishers conceal themselves along the shore as well as possible, and when the turtles come up out of the water on the beach, they rush forth and turn them over on their backs with iron hooks, leaving them secure in this position until morning.

The tortoise shell of commerce is not, as generally believed, the horny covering or shell proper of the turtle; it is the scales which cover the shield. These scales are thirteen in number, eight of them being flat and the other five somewhat curved. Four of those that are flat are quite large, sometimes being as much as twelve inches long and seven inches broad, nearly transparent and beautifully variegated in color with red, yellow, white, and dark brown clouds, which give the effects so fully brought out when the shell is properly polished. A turtle of average size will furnish about eight pounds of these laminæ, or scales, each piece being from an eighth to a quarter of an inch in thickness.

It is the method by which these scales are loosened which is the repulsive part of the business. The turtles are not killed, as that would lead to their extermination in a very few years. After capturing them, the fishers wait for daylight to complete the work. The turtles are turned over again in their natural position and fastened firmly to the ground by means of pegs; then a bunch of dried leaves or sea grass is spread evenly over the back of the turtle and set afire. The heat is not great enough to injure the shell, merely causing it to separate at the joints. A large blade, very similar in shape to a chemist's spatula, is then inserted horizontally between the laminæ, which are gently pried from the back. Great care must be taken not to injure the shell by too much heat, and yet it is not forced off until it is fully prepared for separation by a sufficient amount of warmth.

The operation, as one may readily imagine, is the extreme of cruelty, and many turtles do not survive it. Most of them do live, however, and thrive, and in time grow a new covering, just as a man will grow a new finger nail in place of one he might lose. The peculiarity of the second growth of shell, though, is that instead of reproducing the original number of thirteen segments, it is restored in one solid piece.

To see the operation of taking the shell from the living turtle once is about all a man of Northern breeding wants of it; and if the helpless reptiles had the power of voicing their sufferings under it, their cries would tell of as heartless a business as man has yet engaged in.

HOW FLOWERS ATTRACT INSECTS.

By G. W. BULMAN, in Science Gossip.

IT was Sprengel, rector of Spandau, near Berlin, a botanist so enthusiastic as to neglect his duties as pastor, and consequently to lose his post, who first directed attention to the fertilization of flowers by insects, and to the wonderful way in which the former are adapted to the visits of the latter. After undergoing a period of neglect, the idea was taken up and given a fresh development by Darwin and his followers, but in a different way.

By far the most exhaustive series of experiments which have ever been carried out on this subject are those of Prof. Plateau, of the University of Ghent. These point irresistibly to the other possibility. It is, I believe, beyond dispute that these experiments show that insects are not attracted to flowers by their gay colors. An account of these very interesting observations, under the title of "Comment les Fleurs attirent les Insectes," has appeared from time to time in the Bulletin de l'Académie Royale de Belgique. I propose to give here very briefly an outline of them.

Having covered the gayly colored flowers of single dahlias with green leaves, in some cases the outer ray florets only, in others the whole flower, Prof. Plateau found that insects visited them as freely as before. Such a result, so much at variance with the generally received view that insects are attracted to flowers by their gay colors, seemed to demand further investigation. So Prof. Plateau set himself by a series of experiments and observations exhaustively to cross-question Nature on the subject. The final answer has been a confirmation of the conclusion pointed to in the first experiments, viz., that color plays a very subordinate part in attracting insects to flowers.

The first question put was, "If the gayly colored part of a flower be removed, leaving only the green calyx and the honey-bearing parts, will insects still visit it?" To put this question, Prof. Plateau took two pots of lobelia, each with thirty or forty flowers, and carefully cut off with a pair of scissors all the blue corollas in the one pot, leaving those in the other intact. These pots were placed near together in a sunny situation much frequented by insects. Watching them carefully, thirty-three visits to the blue flowers and twenty-five to the green calyces were counted. When Darwin put the question with the same flower, he got an opposite answer. For having deprived some lobelia flowers of their blue corollas, he found that the bees ceased to visit them.

Prof. Plateau continued his questions with other flowers. He cut off the large, conspicuous yellow corollas of the evening primrose. One bee was seen to visit fourteen of these mutilated flowers in succession. On another occasion one bee visited ten, another three and another fifteen of these flowers without corollas. Similar results were obtained with the flowers of Convolvulus major, larkspur, cornflower, and foxglove. When, however, the question was put with snapdragon the answer seemed different; insects did not visit the remaining green parts. Prof. Plateau thinks this may have been because the mouth of the green calyx of this flower is directed upward, while insects generally attack such flowers from below. In any case one negative answer cannot alter the obvious conclusions from the many positive ones.

Another answer to the question comes from the well-known fact that insects pass freely from one color to another among our garden flowers. Prof. Plateau rightly claims this as supporting his view. He himself has seen them pass freely from color to color in a bed containing blue, purple, rose, and white cornflowers; in a patch of red, scarlet, purple, rose, yellow, orange, and white single dahlias; and from the vivid red of the garden flax to the bright blue of the common flax. Other writers, including Darwin, have observed the same thing.

The question, however, may be put in another form. There are certain brilliantly colored flowers which insects scarcely ever visit. Now, if insects are attracted rather by perceiving in some way that honey is present than by the colors of flowers, then they ought to be attracted to such flowers when honey is placed in them. So Prof. Plateau chose the scarlet geranium of our gardens, and placed some honey on a few of the flowers. In the course of an hour these honeyed flowers were visited by eight humble bees; and when these bees, in the course of gathering honey from these honeyed flowers, came to those without it, they flew over them without alighting. Phlox, Japanese anemone, and the larger bindweed were treated in the same way, and with similar results.

Again, if the honey-bearing parts of flowers be removed, leaving the gay corolla, then if insects are not attracted chiefly by color, they should cease to visit them. The question was then put in this form. The central florets of single dahlias, which alone secrete honey, were carefully removed, and bits of yellow leaf put in their place. No insects came to visit the flowers thus treated. As soon as a drop of honey was placed on these artificial disks, then insects were attracted as freely as before. The disks were then removed, and a little honey placed in the central space. Again insects were quickly attracted.

Another answer comes from the habits of insects in visiting flowers. There are a number of plants with inconspicuous flowers, usually fertilized by the wind, and hence known as "anemophilous." These have no gayly colored corollas to advertise their honey or pollen, yet not a few of them, as certain species of Chenopodium, nut, docks, rushes, and grasses, are, on authority of various authors, visited by insects. Insects would not visit these flowers if they required the stimulus of color to attract them.

Yet again, the question may be put in another form. If insects are attracted to flowers not by gay color, but by the perception of honey, then if honey be placed in

such inconspicuous anemophilous flowers as are seldom or never visited by insects, the latter ought then to be attracted. This was found to be the case. Honey was placed on seventeen species of such flowers, including Chenopodium, hemp, hop, nettles, reeds, and grasses, and in each case insects were attracted.

We ought also to obtain an answer to our question by noting the colors of flowers freely visited by insects. If they are chiefly drawn by gay colors, then we should expect to find them rather avoiding the green and inconspicuous ones. So Prof. Plateau brings forward a list of green, greenish, brown, or brownish flowers, freely visited by insects. This list, containing ninety-one species in all, includes such flowers as hellebore, ladies' mantel, ivy, currants, figwort, spurge, asparagus, lime, sycamore, raspberry, wood sage, etc. All these, on the authority of Prof. Plateau himself and others, are freely visited.

Prof. Plateau's final questionings were made with artificial flowers. These were made to imitate lilac, forget-me-not, saxifrage, and foxglove. Being placed among natural flowers, they entirely failed to attract insects. Even when honey was placed in them, none came. Obviously, then, insects are not attracted by such artificial colors. The fact that even honey failed to bring them seems to show that they had some distrust of the artificial flowers. Then Prof. Plateau altered the form of this final question. He now made some artificial flowers of bits of green leaves of red currant and of sycamore, placing a little honey in each. To these strange looking flowers, unlike anything they had seen before, insects came freely for the honey.

From all this cross-questioning of Nature Prof. Plateau claims to be entitled to draw the following conclusion: "Insects seem to care little either for the presence or absence of floral parts of brilliant colors. That which they desire is pollen or nectar, and they are guided in a very subordinate way by sight, but on the contrary in a sure way by another sense, which can only be smell."

If we admit his facts, we cannot escape from Prof. Plateau's conclusions: no explaining away is possible. But if we accept the inference that insects are not attracted to flowers by their gay colors, can we retain a belief in the insect selection theory of the origin of flowers? Giving up the assumption that brilliant colors are the attraction and guide to insects, we take away a plank from the hull of the little bark of theory which has sailed so gayly these many summers over the seas of popular scientific literature; and the leak is fatal.

THE BACTERIOLOGICAL TREATMENT OF SEWAGE.

AN exceedingly important paper relating to the treatment of sewage was read before the recent meeting of the Society of Chemical Industry by Mr. W. J. Dibdin and Mr. G. Thudicum. It is now well recognized that the most efficient method of rendering innocuous ordinary domestic sewage is to rely, not on chemical treatment, but on the natural purification effected by putrefactive and nitrifying bacteria, which in the end entirely destroy the offensive organic matter contained in the crude sewage. It has, however, been suggested that these agencies would prove much less effective in dealing with the sewage from large manufacturing towns, which is often heavily charged with trade refuse. At Sutton, where the sewage is practically entirely domestic, though very strong, the bacteriological method of purification has been in successful operation for eighteen months, but it by no means followed that equally successful results would be obtained with the sewage from such a town as Leeds, where the waste liquors from the tanneries, galvanizing works, copper-precipitation works, and much shoddy waste all passed into the main sewers. However, a bacteria bed was made up at the Knostrop works in October last. The material used was coke, the upper layer of the bed consisting of a depth of 4 feet 6 inches of coarse coke, while the lower bed, 5 feet thick, was of finer material. The sewage passed through amounted to 200,000 gallons per day. During the first three months the sewage was passed on to the bed direct, with the result that a quantity of fibrous material, mainly wool waste, accumulated on the surface of the bed. This did not appear to affect the character of the final effluent, but did reduce the water capacity of the bed. Seven weeks were required to bring the bed into proper working condition, but following this the oxidizing action became so powerful that the ferrous salts in the crude sewage were often found in the ferric state in the effluent. This latter is so pure that fish live in it. At Maidstone similar experimental works have been undertaken. Here the trade refuse comes from breweries and tanneries, and, so far, very promising results have been obtained in laboratory experiments with the crude sewage from this town. At West Bromwich the experimental filters have also proved satisfactory, though here the sewage is largely charged with waste pickle liquors from galvanizing works. The worst raw sewage in the country is supposed to be that from Yeovil, where the manufacture of glove leather forms the principal industry. In addition to particularly noxious organic matter, this sewage contains arsenic, which is largely employed in the preparatory treatment of the leather. Here the septic-tank system has been instituted, the crude sewage being kept for some hours in a closed tank, where the anaerobic bacteria bring into solution a very large proportion of the solid matters originally suspended in the liquid. This done, the sewage is next passed through filter beds, where the process of purification is completed by the oxidization of the organic matter. Messrs. Dibdin and Thudicum have also experimented directly on trade effluents before the latter have been mixed with domestic sewage. Good results have been obtained in all cases, except in that of gas works liquors, which needed dilution before being passed into the bacteria beds.—Engineering.

Substances Evolving Light on Trituration.—It is a well known fact that some substances are luminous on trituration in darkness. This phenomenon can be excellently observed when lump sugar is grated in the dark. Substances which are luminous on being rubbed up in the dark are: acetanilid, antipyrin, quinine valerianate, cocaine hydrochlorate, cocaine, pilocarpine hydrochlorate, salophen and salipyrin.—Pharmaceutische Centralhalle.

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